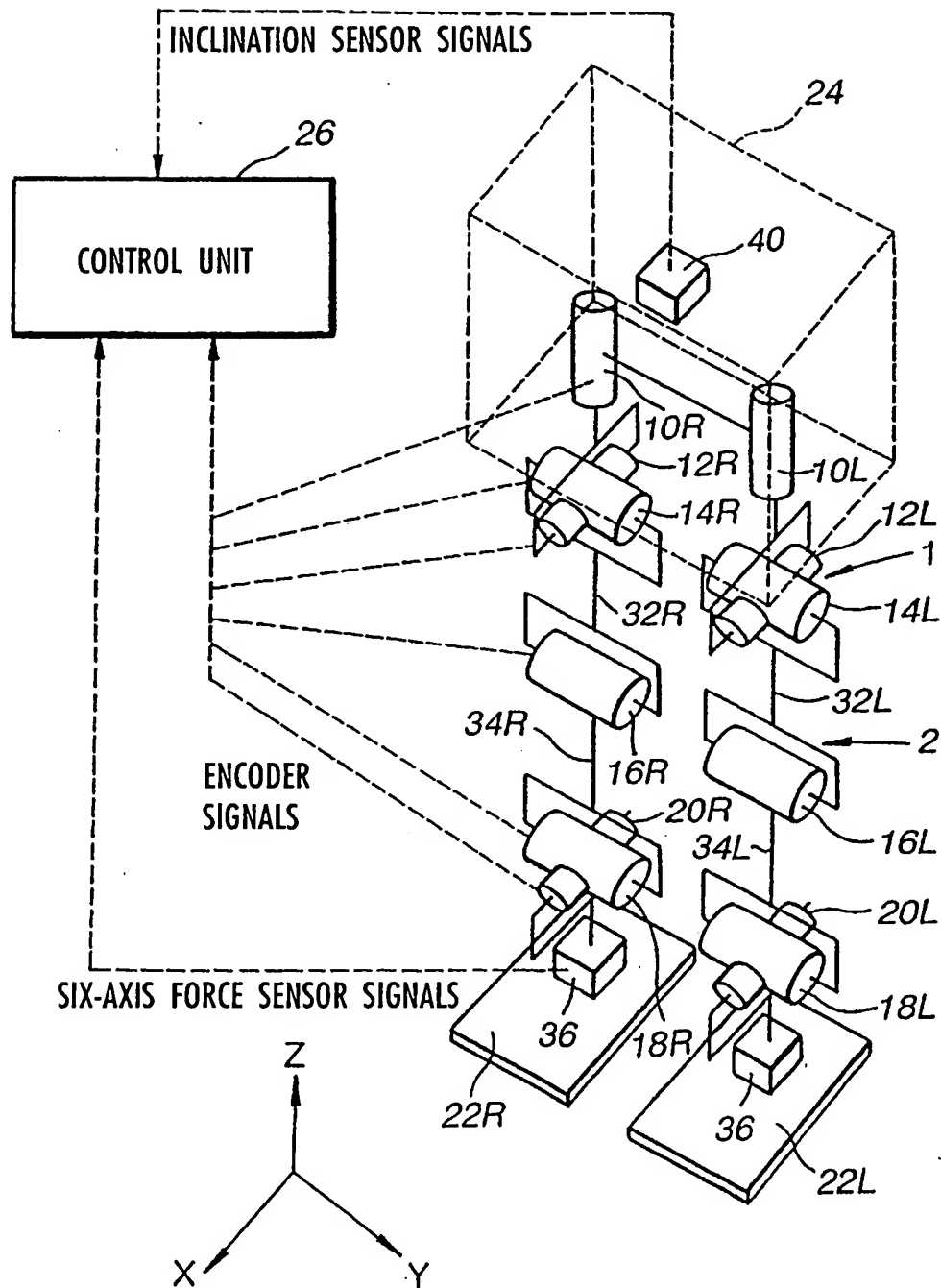


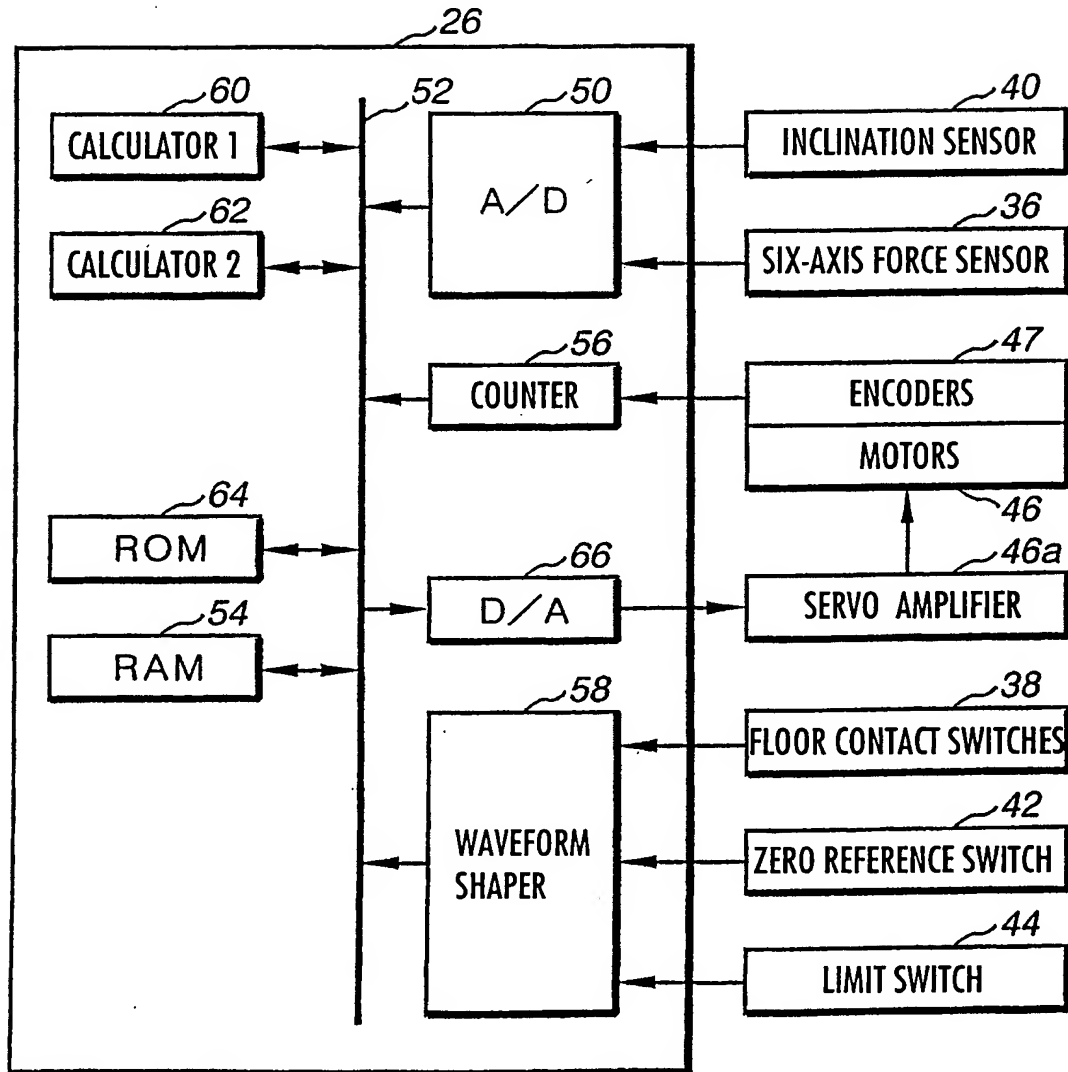
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FIG.1



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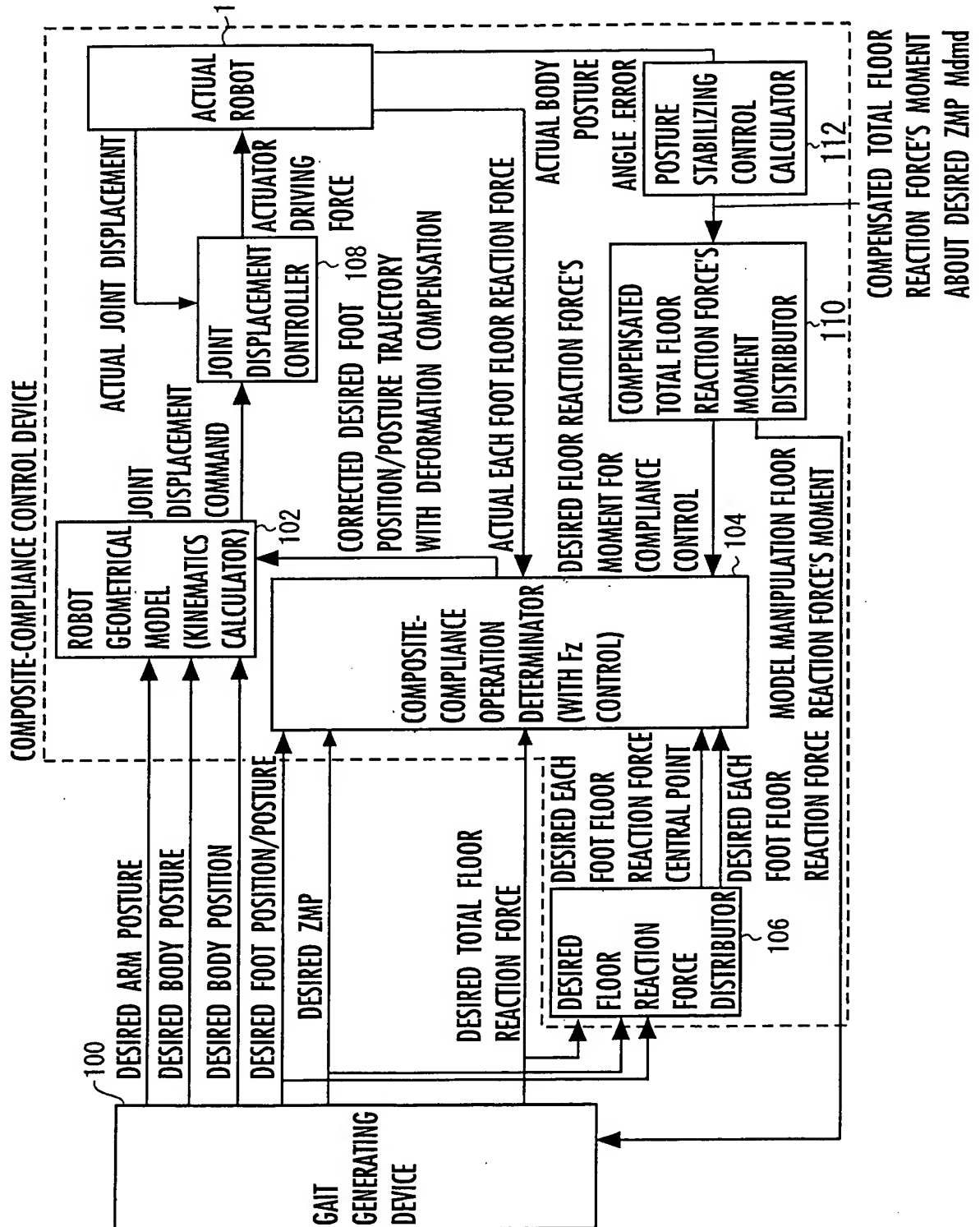
FIG.2



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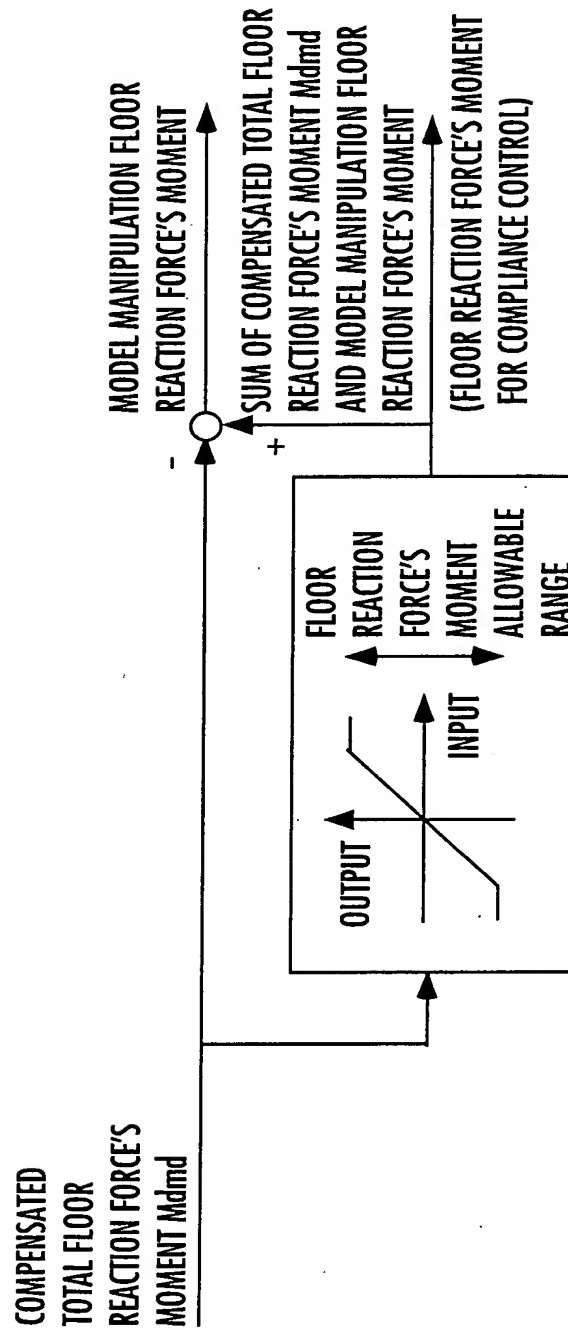
FIG.3



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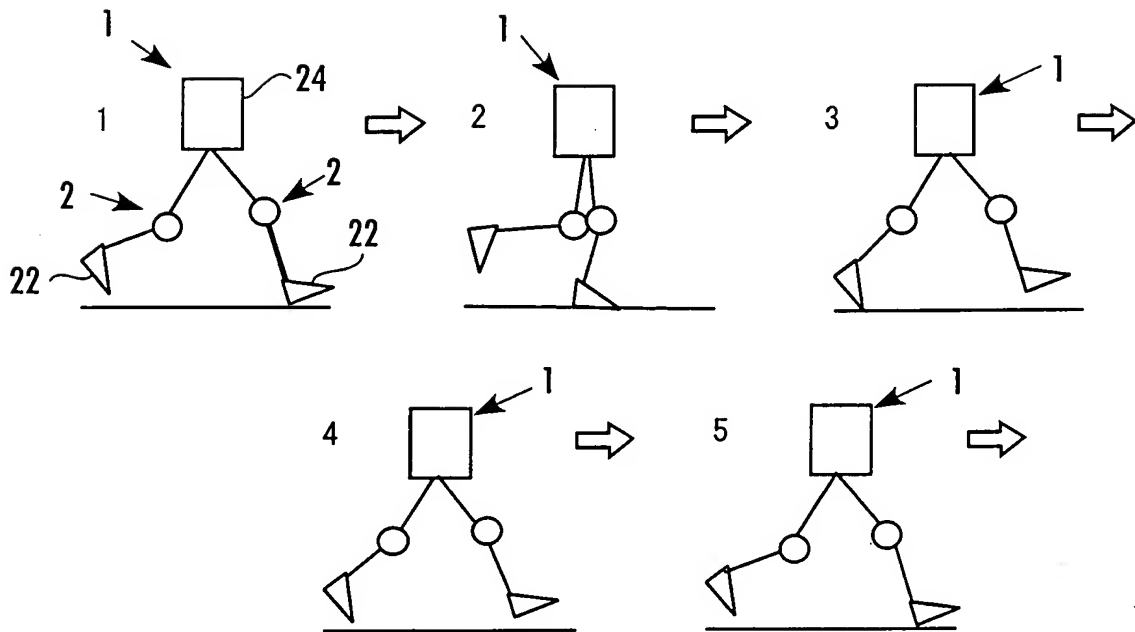
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FIG.4



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FIG.5
(RUNNING GAIT)



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FIG.6

(DESIRED FLOOR REACTION FORCE'S VERTICAL COMPONENT)

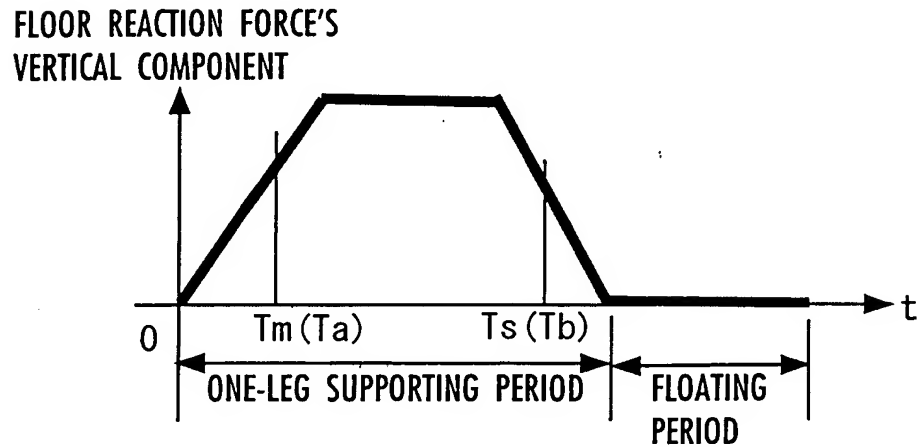
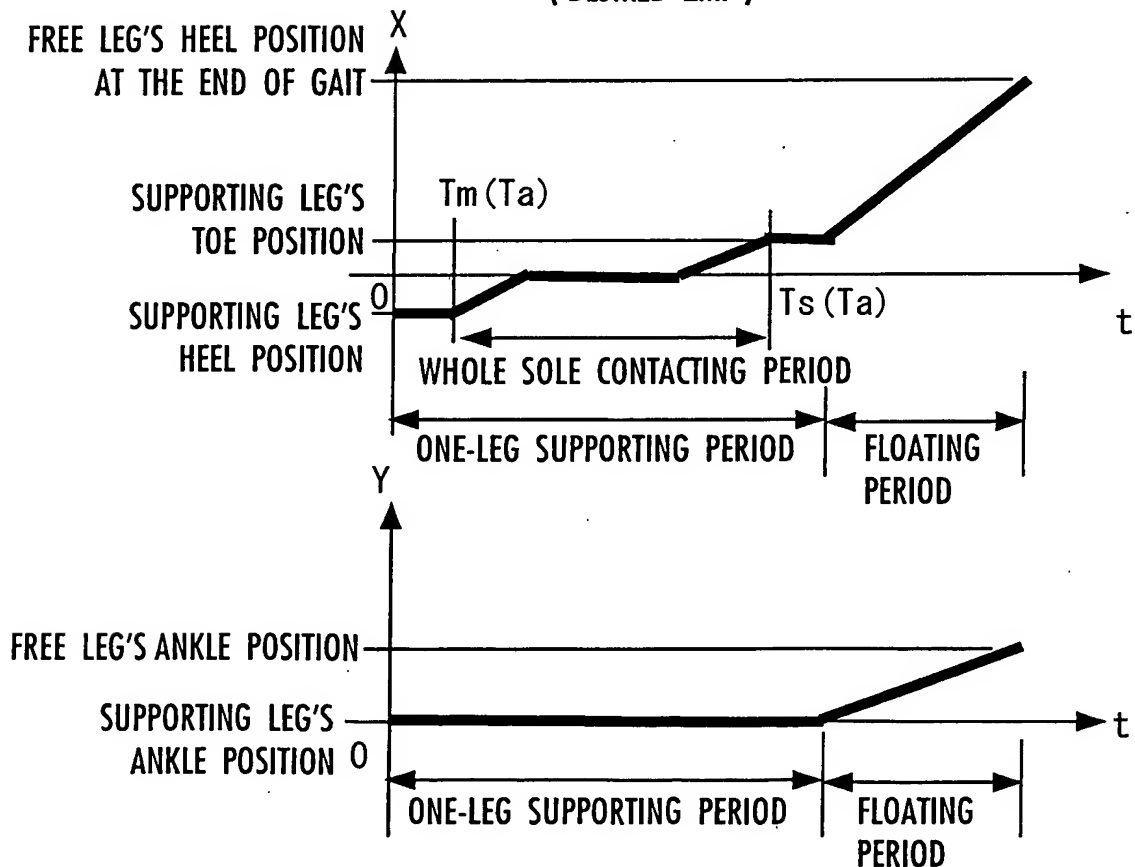


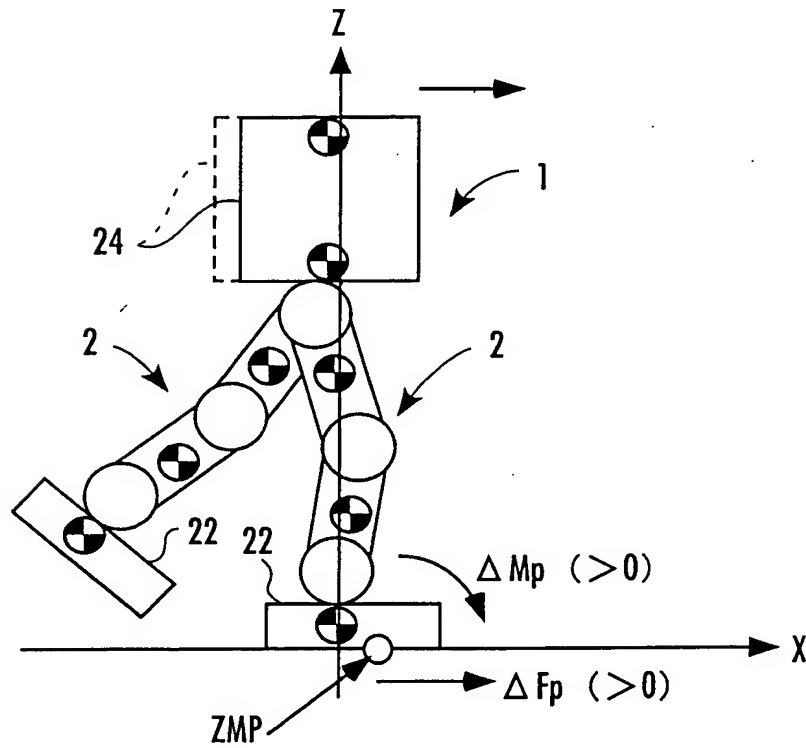
FIG.7

(DESIRED ZMP)



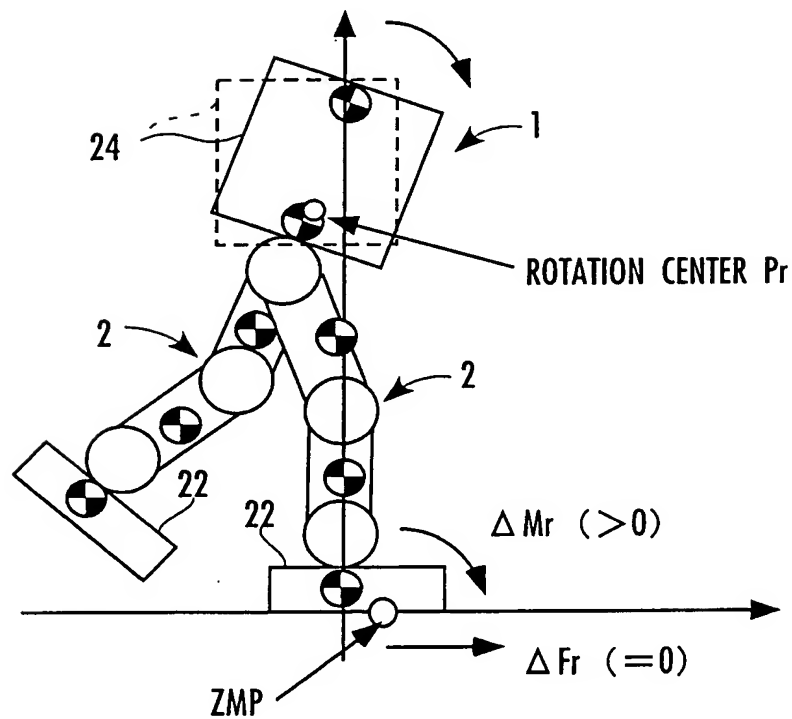
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FIG.8
(BODY TRANSLATION MODE)



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FIG.9
(BODY ROTATION MODE)



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 FIG.10

(SIMPLIFIED MODEL WITH FLYWHEEL)

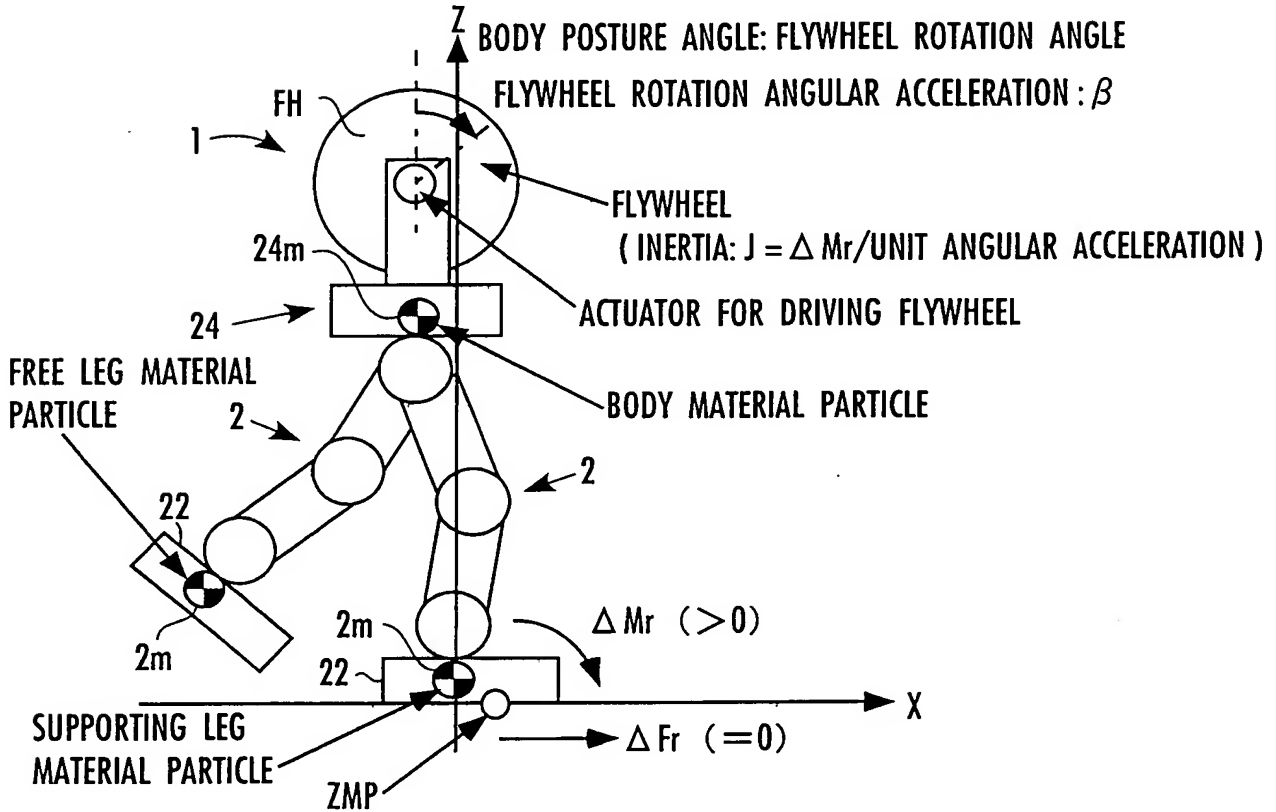
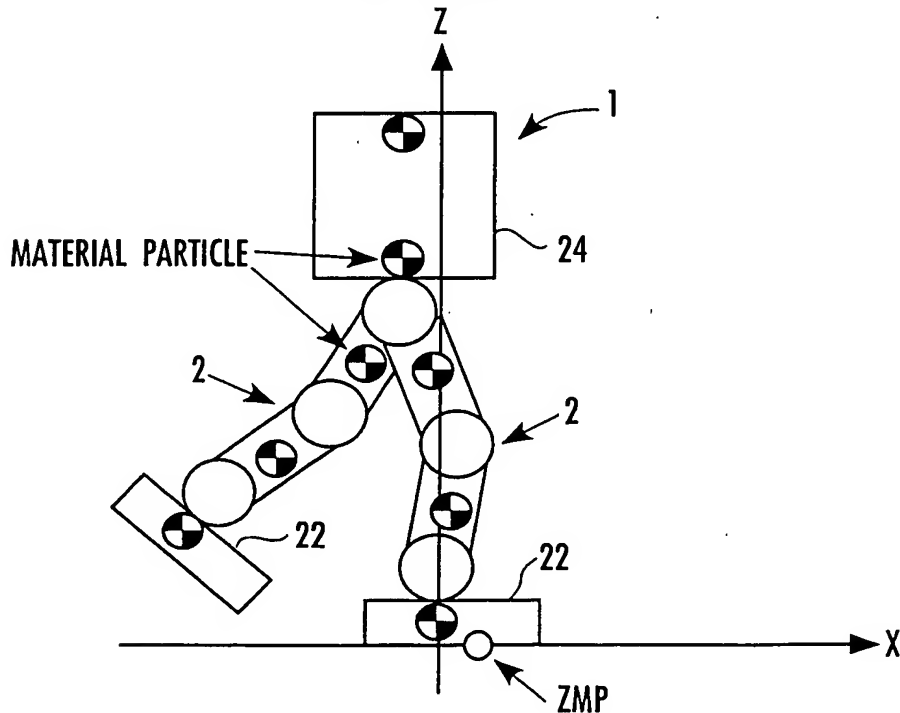
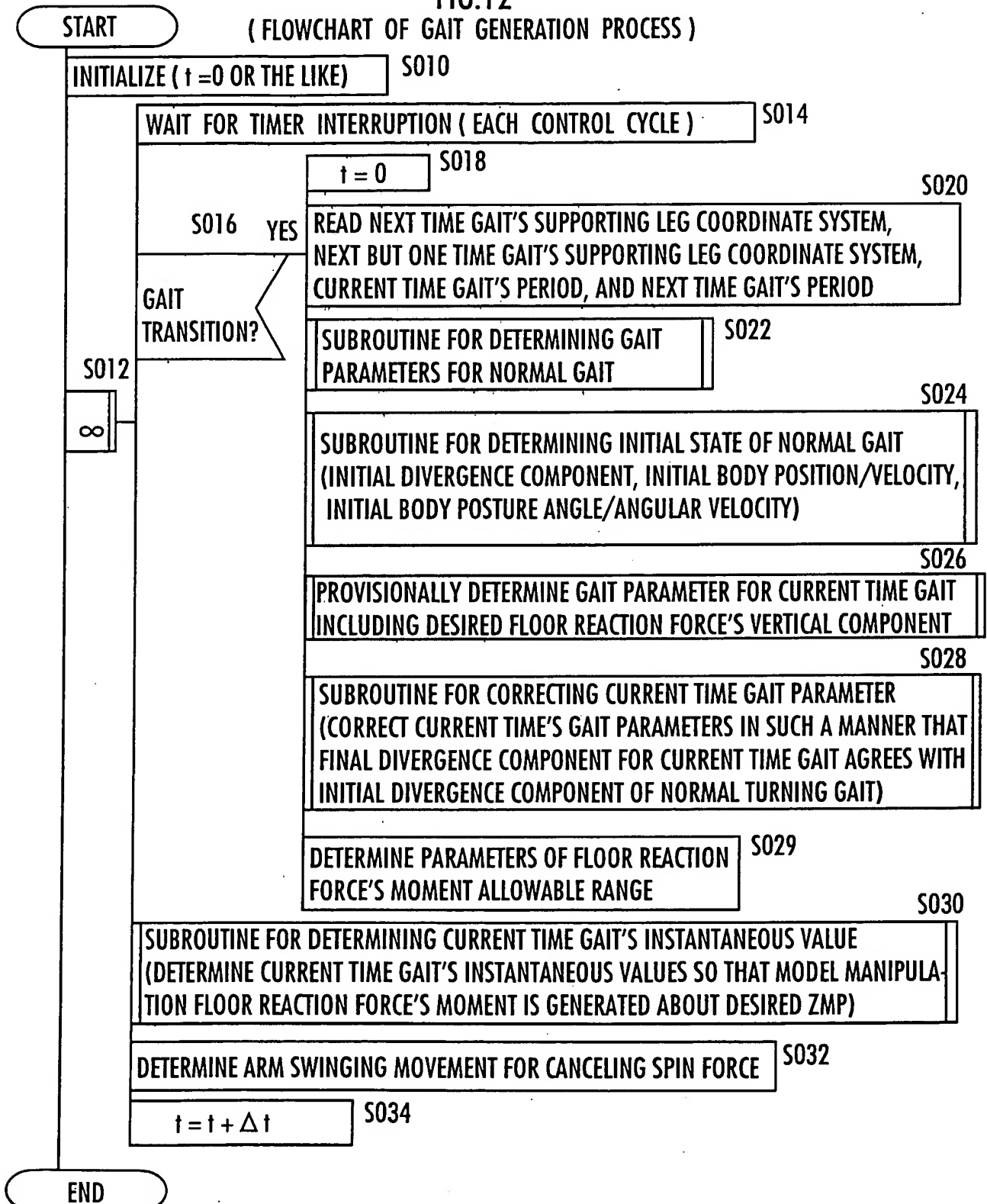


FIG.11
 (FULL MODEL)



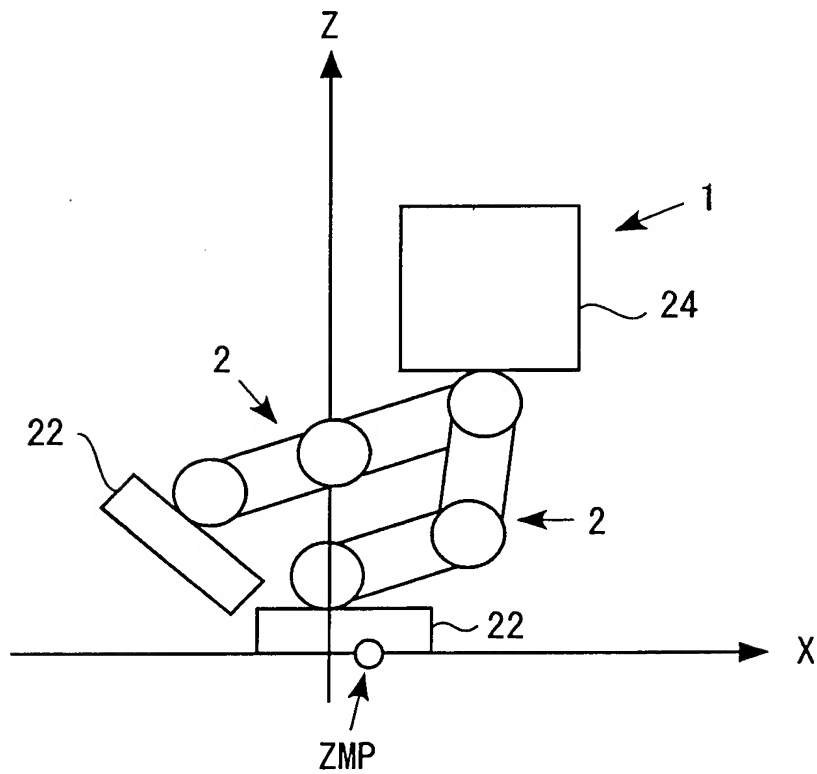
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FIG.12



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FIG.13
(DIVERGENCE STATE OF BODY POSITION)

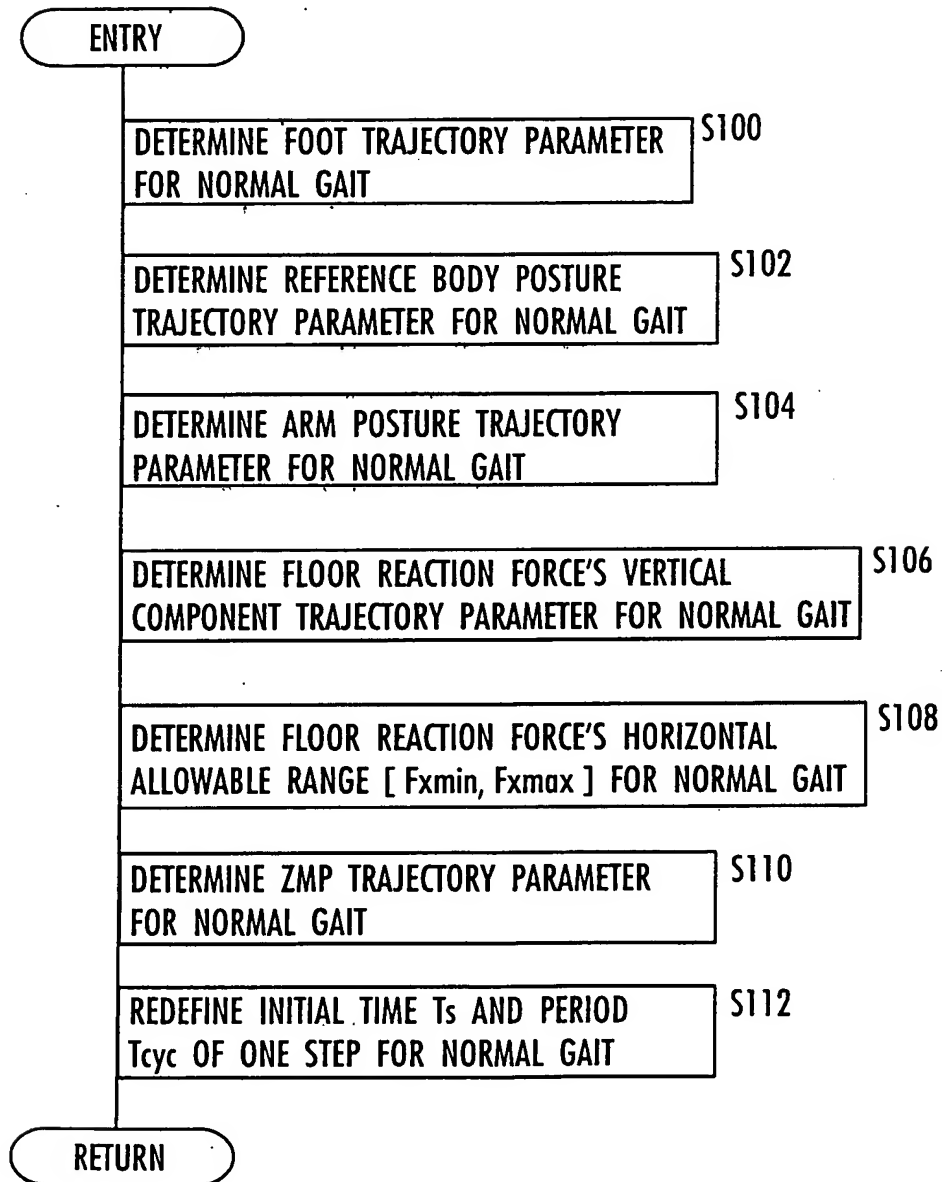


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FIG.14

(PROCESS OF DETERMINING NORMAL GAIT PARAMETER)



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FIG.15

(RELATIONSHIP AMONG FOOT LANDING POSITIONS/POSTURES FOR NORMAL GAIT)

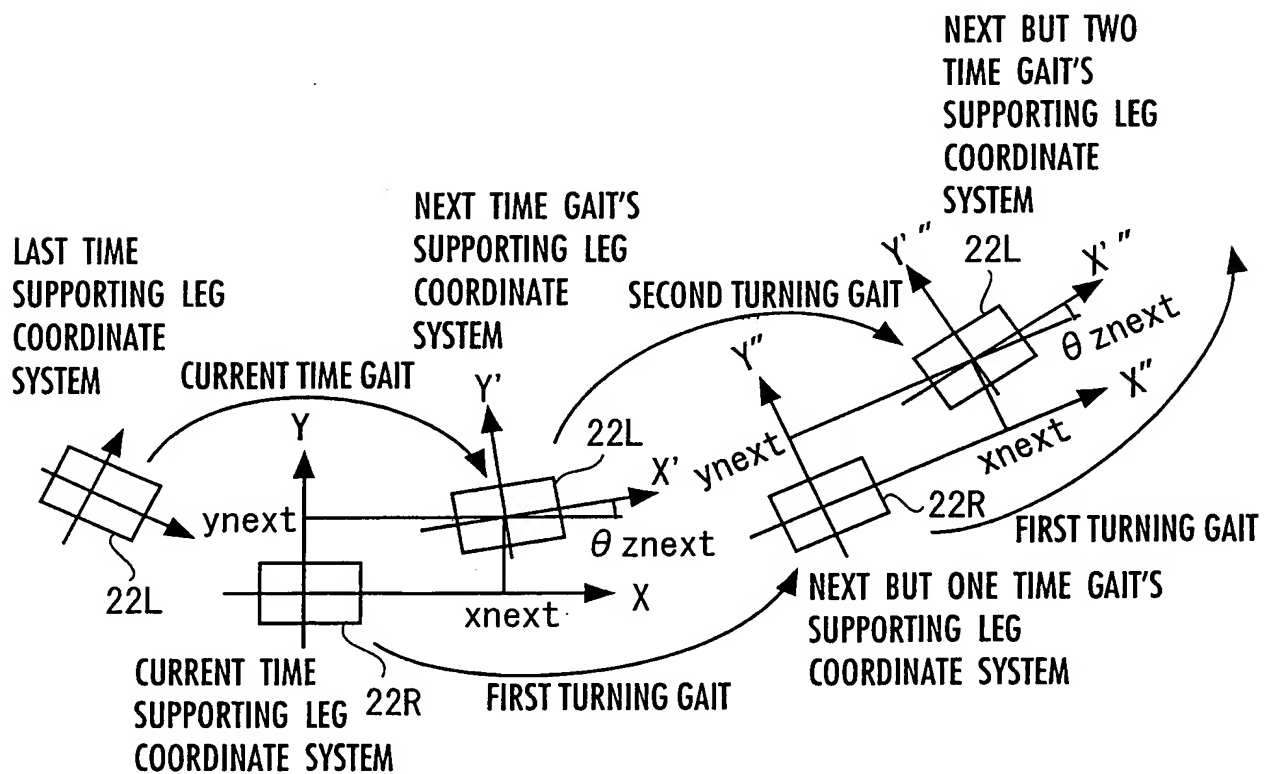


FIG.16

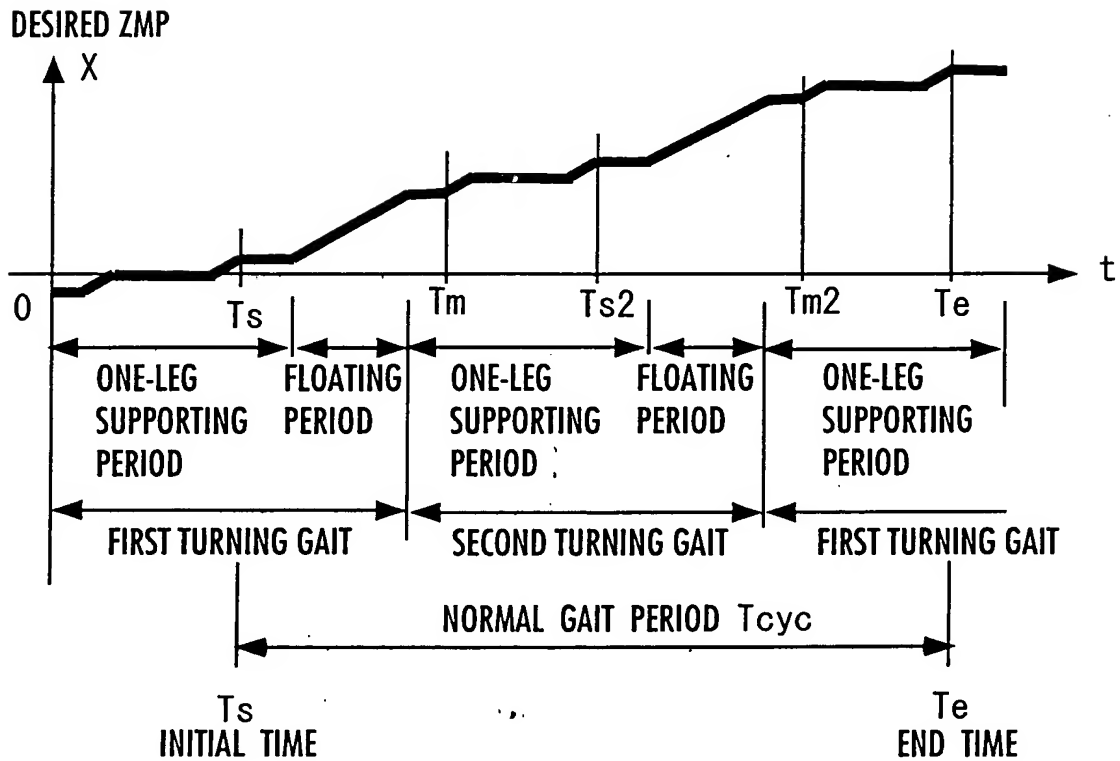
FLOOR REACTION FORCE'S VERTICAL COMPONENT



The graph illustrates the variation of ground reaction force (F) over time (t) for a normal gait cycle. The vertical axis represents force, with F_{max} at the peak and F_{xmin} at the trough. The horizontal axis represents time, with T_s as the initial time and T_e as the end time. The gait cycle is divided into three main phases: ONE-LEG SUPPORTING PERIOD, FLOATING PERIOD, and ONE-LEG SUPPORTING PERIOD. The first and third supporting periods are labeled as FIRST TURNING GAIT, and the middle floating period is labeled as SECOND TURNING GAIT. The total duration from T_s to T_e is labeled as NORMAL GAIT PERIOD T_{cyc} .

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FIG.18
 (DESIRED ZMP)

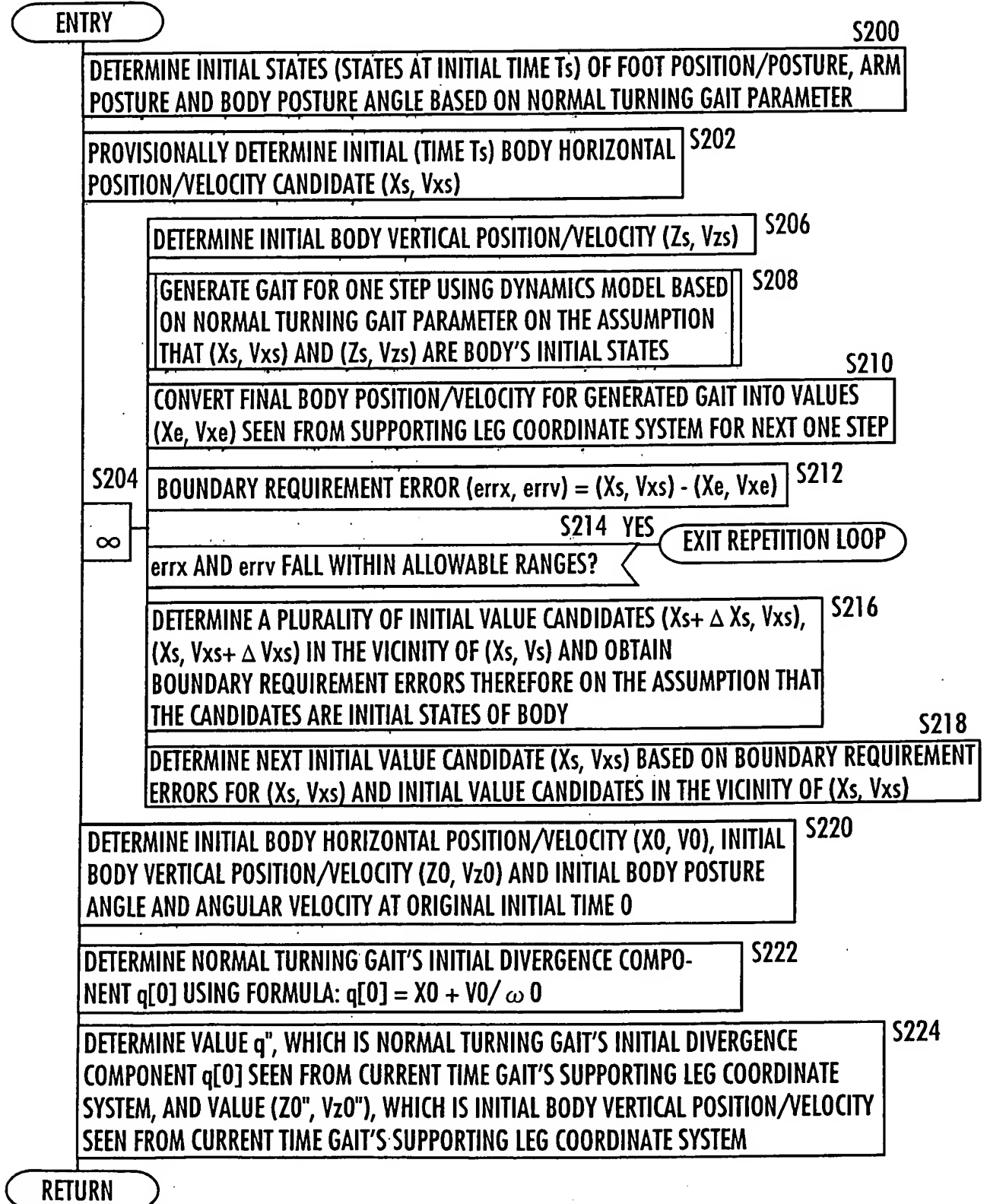


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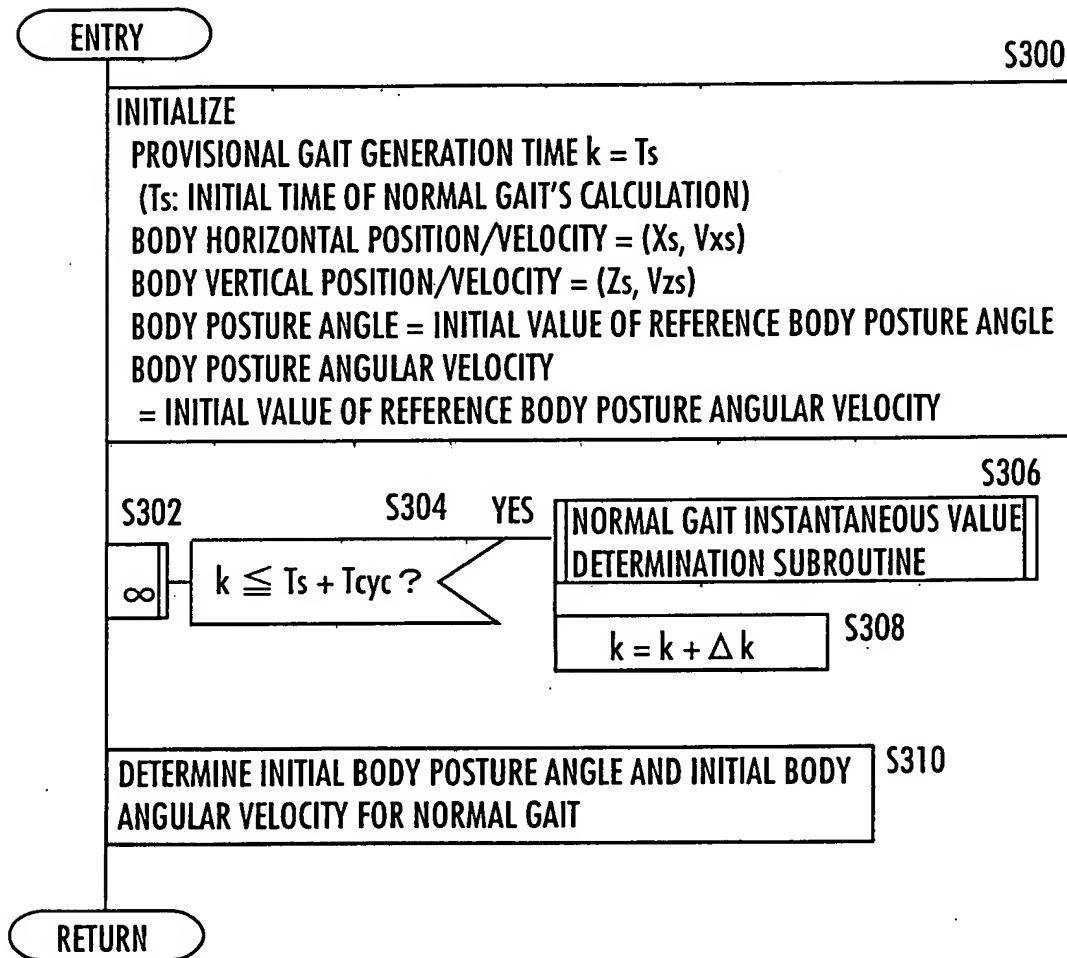
FIG.19

(PROCESS OF SEARCHING INITIAL DIVERGENCE COMPONENT FOR NORMAL GAIT)



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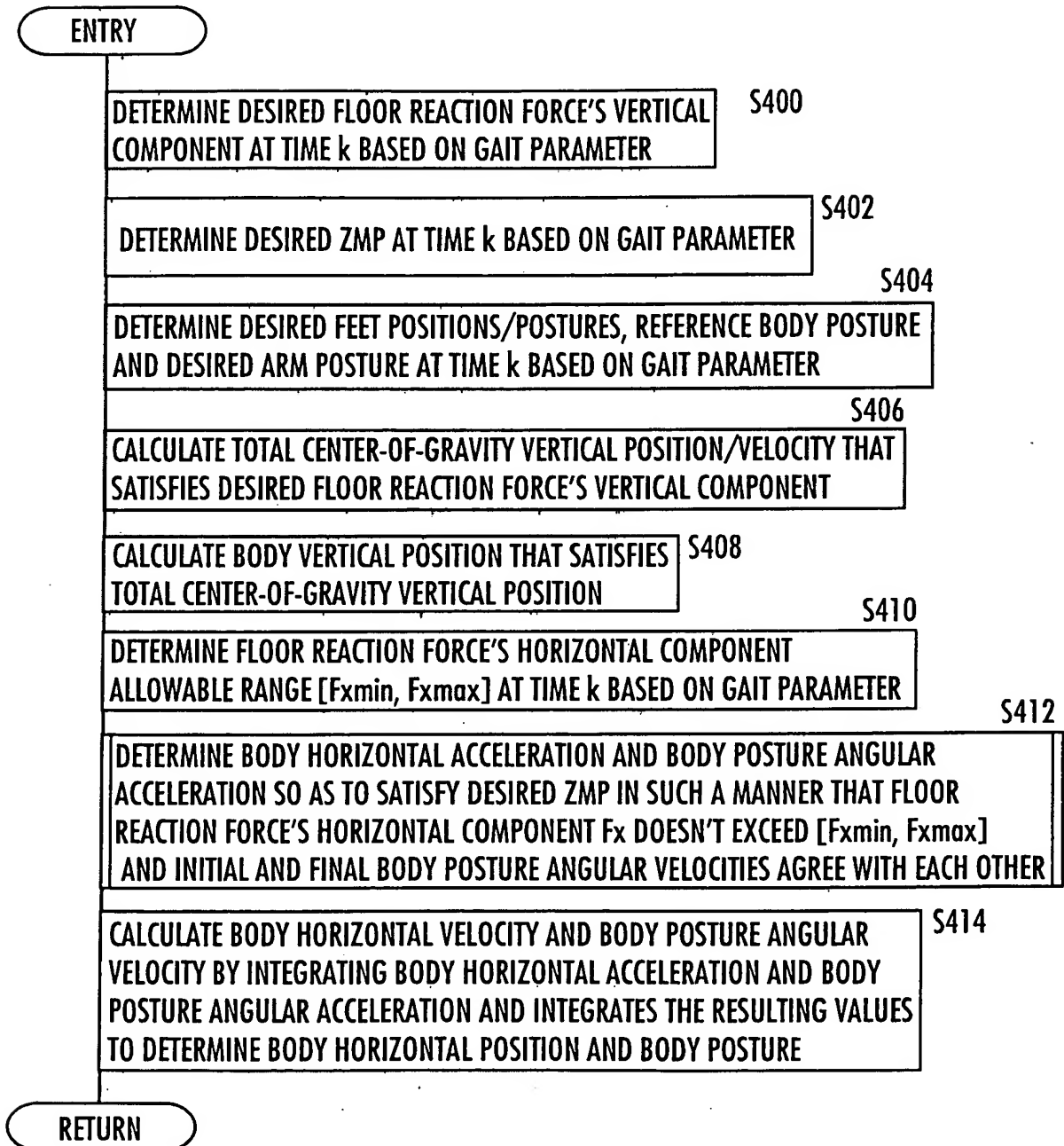
FIG.20
 (PROVISIONAL GAIT GENERATION PROCESS FOR NORMAL GAIT)



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FIG.21

(PROCESS OF DETERMINING NORMAL GAIT INSTANTANEOUS VALUE)

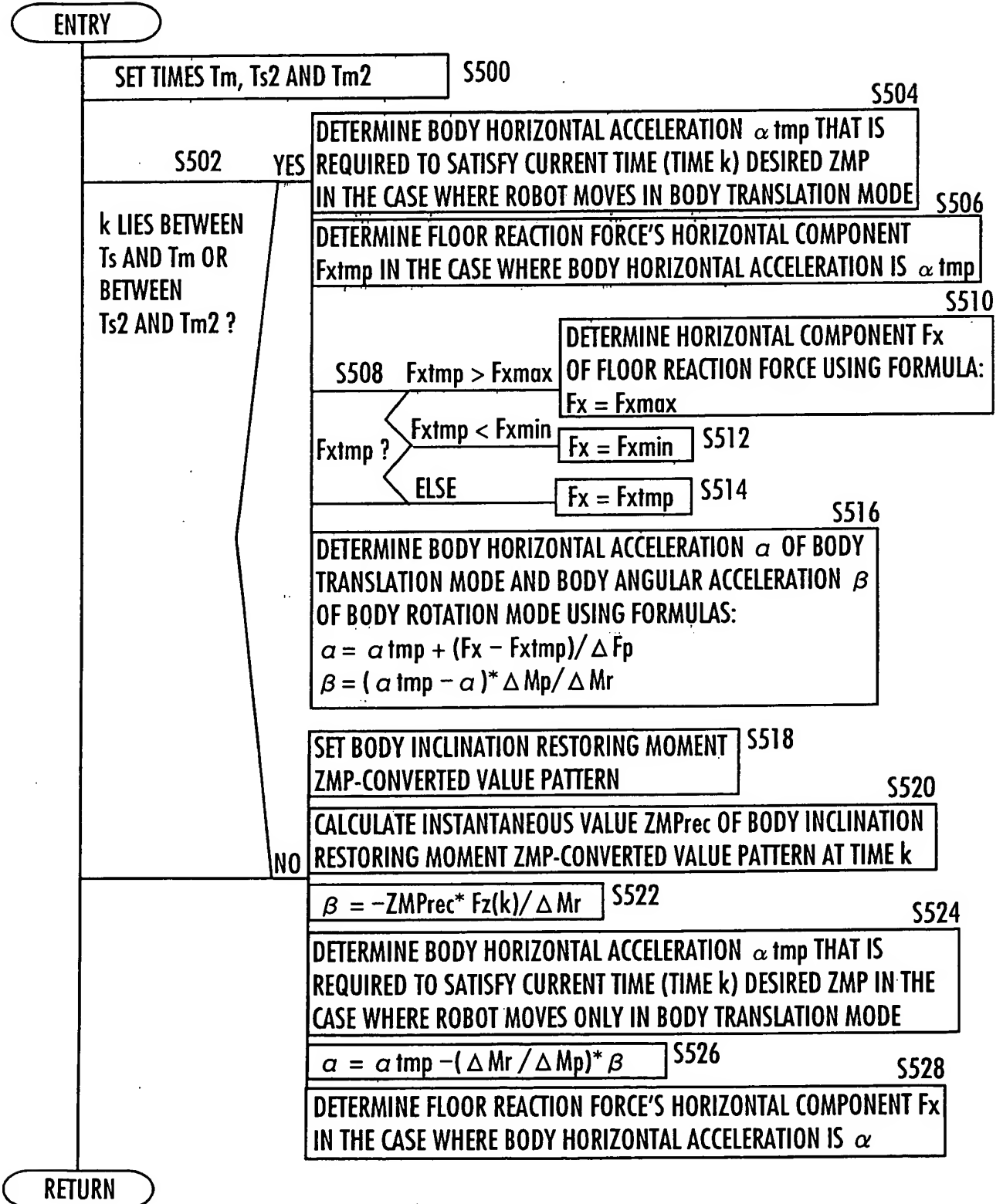


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FIG.22

(PROCESS OF DETERMINING BODY HORIZONTAL ACCELERATION
 AND BODY POSTURE ANGULAR ACCELERATION FOR NORMAL GAIT)



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FIG.23

FLOOR REACTION FORCE'S HORIZONTAL COMPONENT
 DETERMINED WITHOUT TAKING ALLOWABLE RANGE INTO CONSIDERATION F_{xtmp}

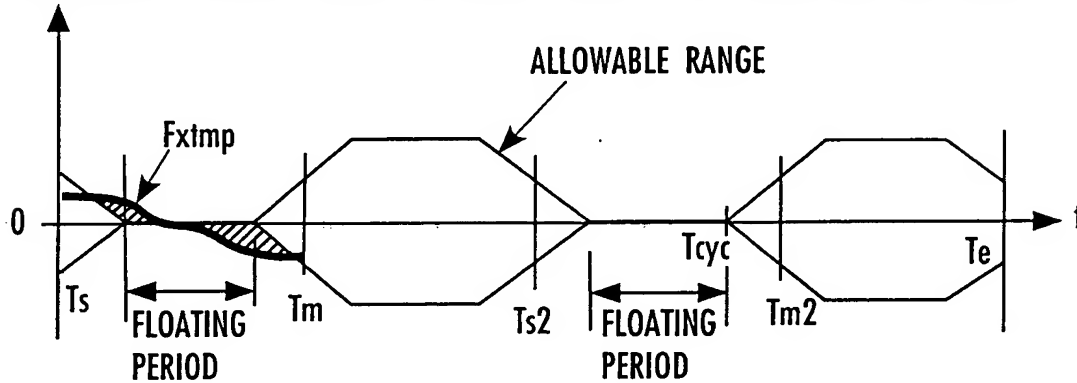


FIG.24

FLOOR REACTION FORCE'S HORIZONTAL COMPONENT
 DETERMINED TAKING FLOOR REACTION FORCE'S HORIZONTAL
 COMPONENT ALLOWABLE LIMIT INTO CONSIDERATION F_x

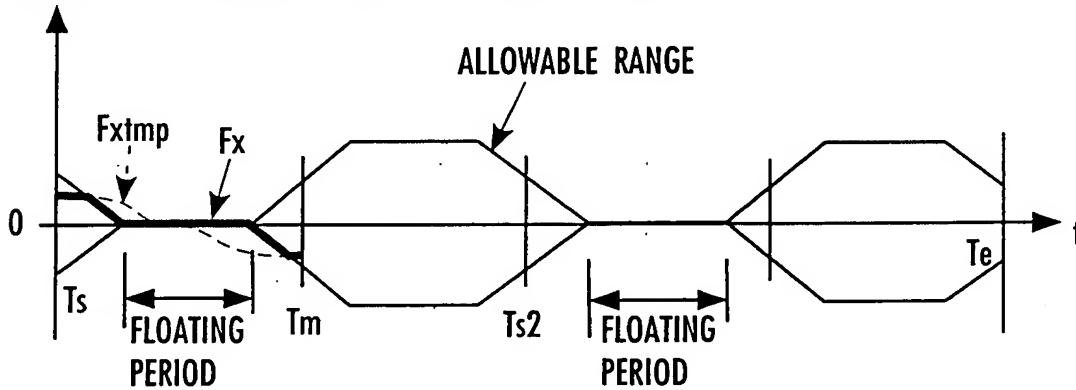
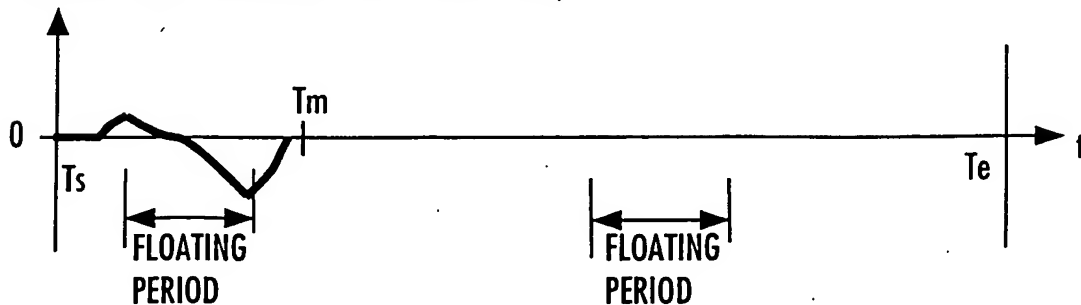


FIG.25

BODY INCLINATION ANGULAR ACCELERATION β



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FIG.26

BODY INCLINATION RESTORING MOMENT ZMP-CONVERTED VALUE
 (ZMP_{Prec})

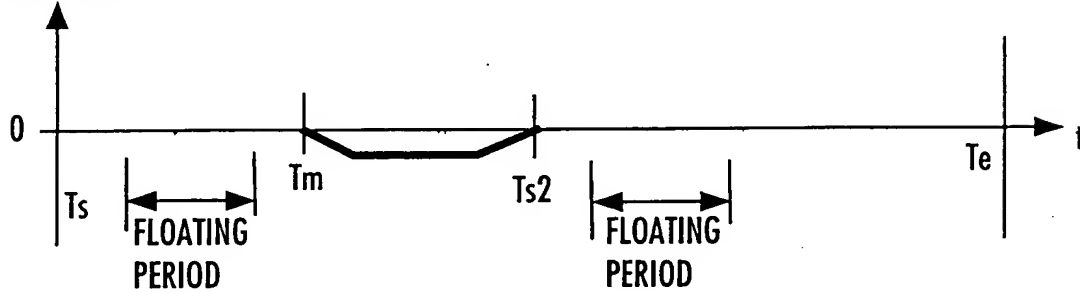


FIG.27

BODY INCLINATION ANGULAR ACCELERATION β
 (FOR RETURNING BODY INCLINATION VELOCITY TO INITIAL VALUE)

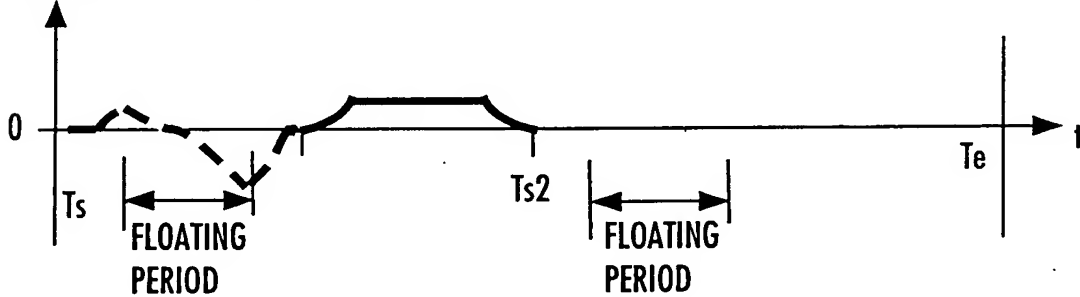
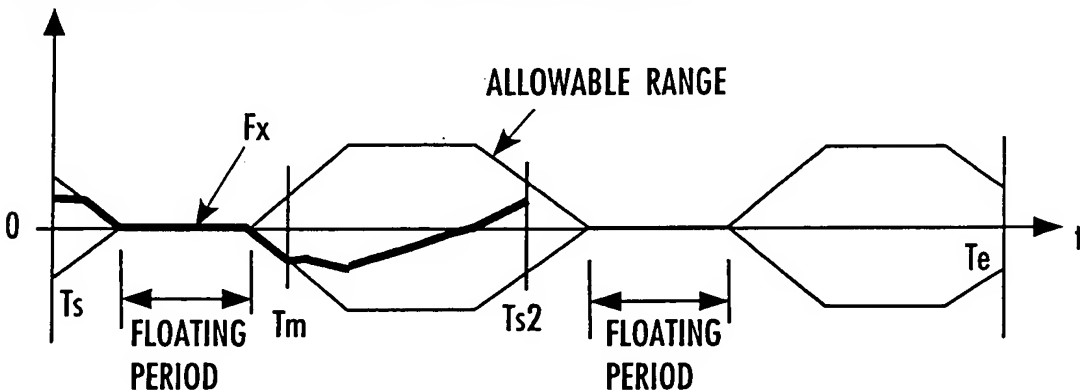


FIG.28

FLOOR REACTION FORCE'S HORIZONTAL COMPONENT F_x
 DETERMINED TAKING FLOOR REACTION FORCE'S HORIZONTAL
 COMPONENT ALLOWABLE RANGE INTO CONSIDERATION



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FIG.29

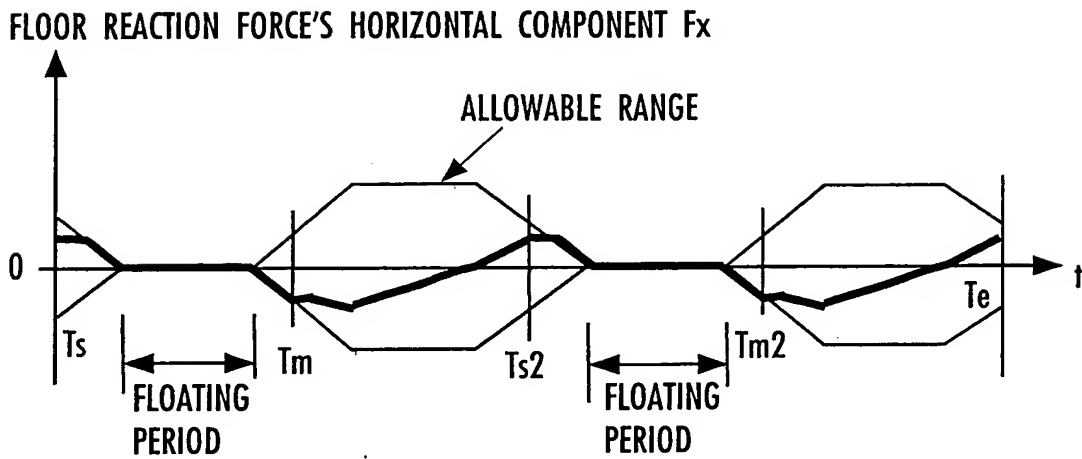
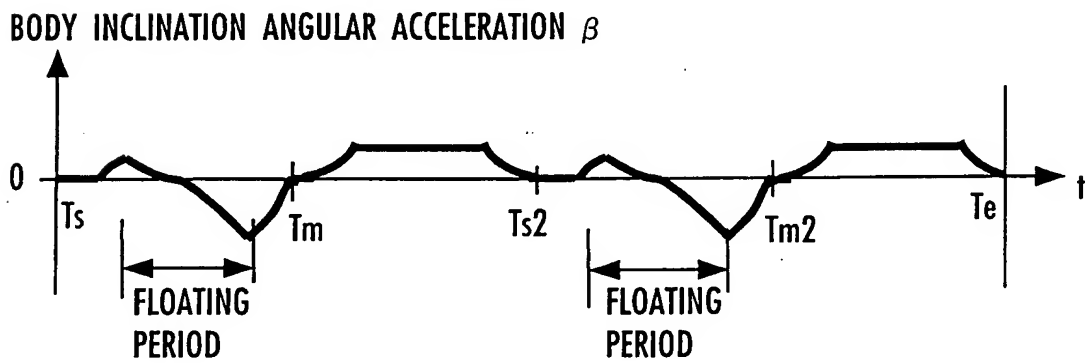
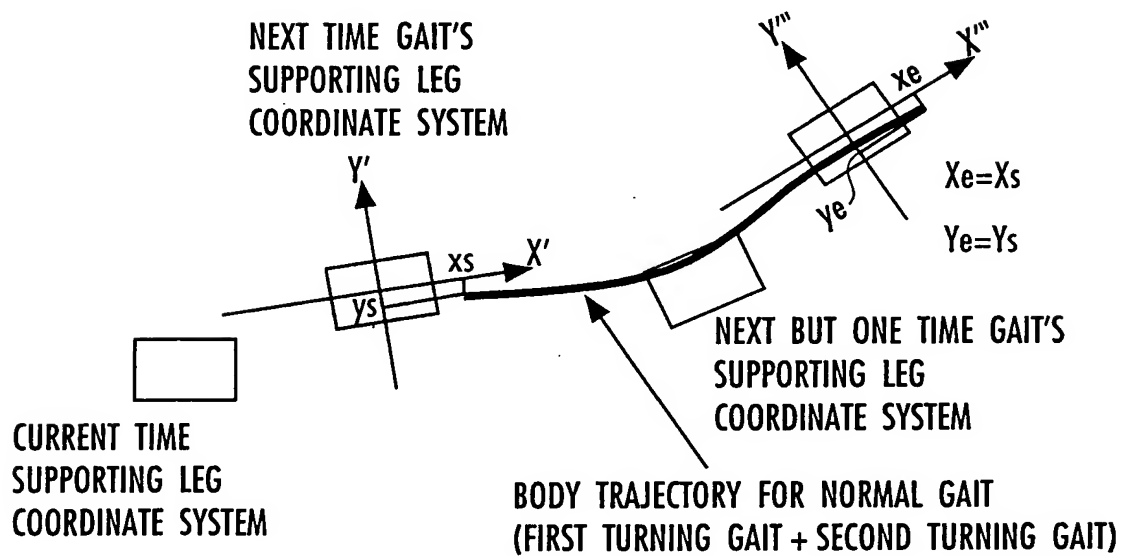


FIG.30



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FIG.31
(RELATIONSHIP AMONG BODY POSITIONS
AT THE TIME OF LANDING FOR NORMAL GAIT PARAMETER)



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FIG.32

(PROCESS OF PROVISIONALLY DETERMINING CURRENT TIME GAIT PARAMETER)

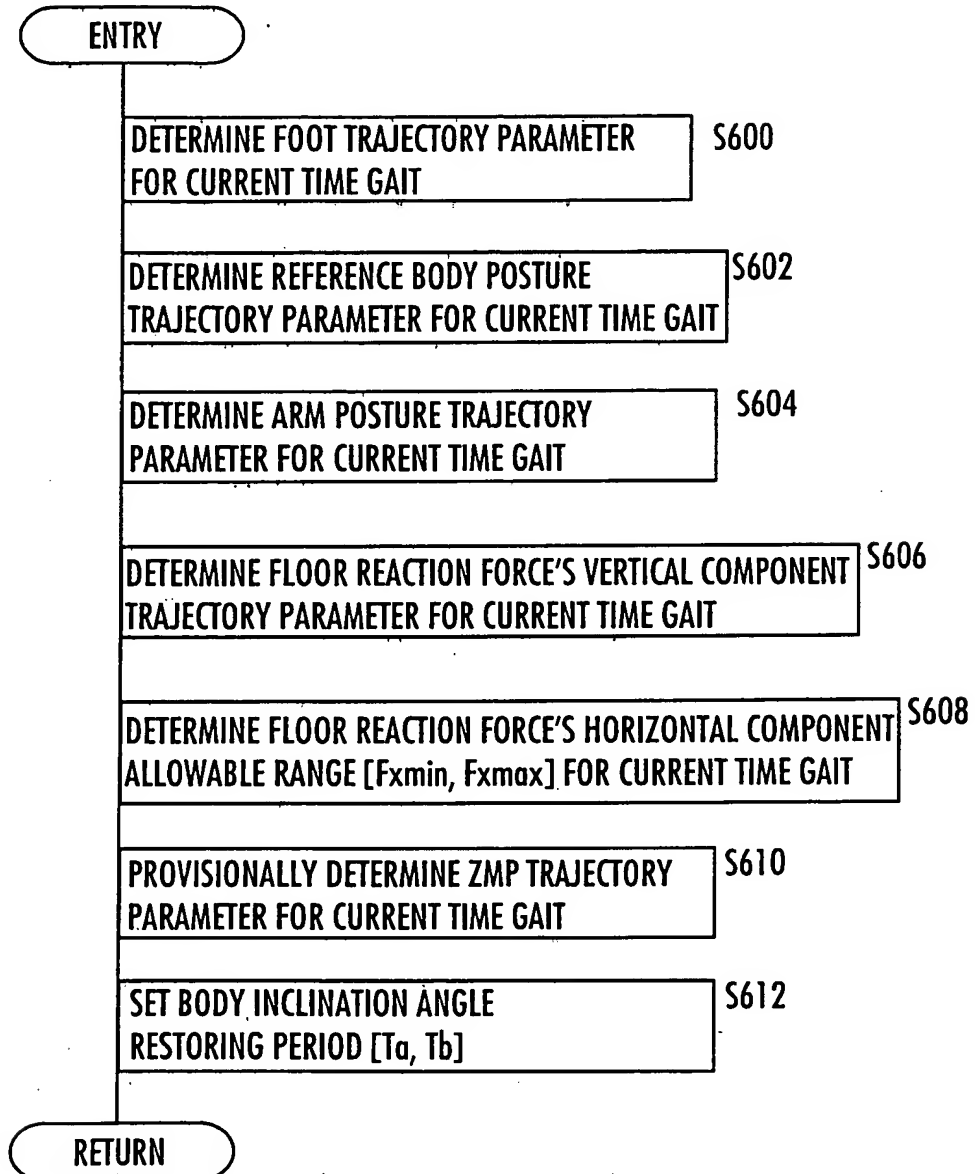
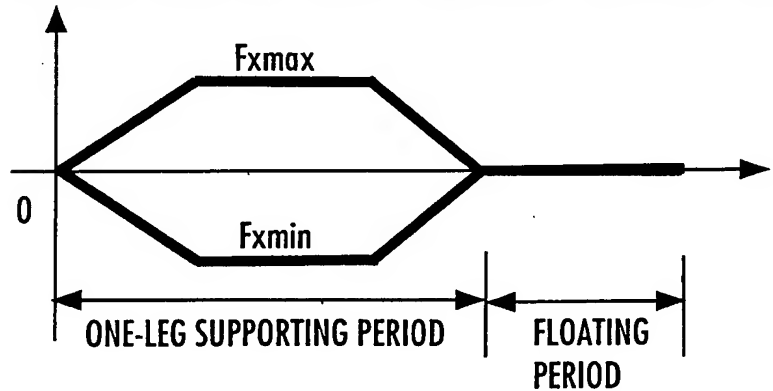


FIG.33
(FLOOR REACTION FORCE'S HORIZONTAL COMPONENT ALLOWABLE RANGE)

LOWER LIMIT VALUE F_{xmin} AND UPPER LIMIT VALUE F_{xmax}
OF FLOOR REACTION FORCE'S HORIZONTAL COMPONENT ALLOWABLE RANGE

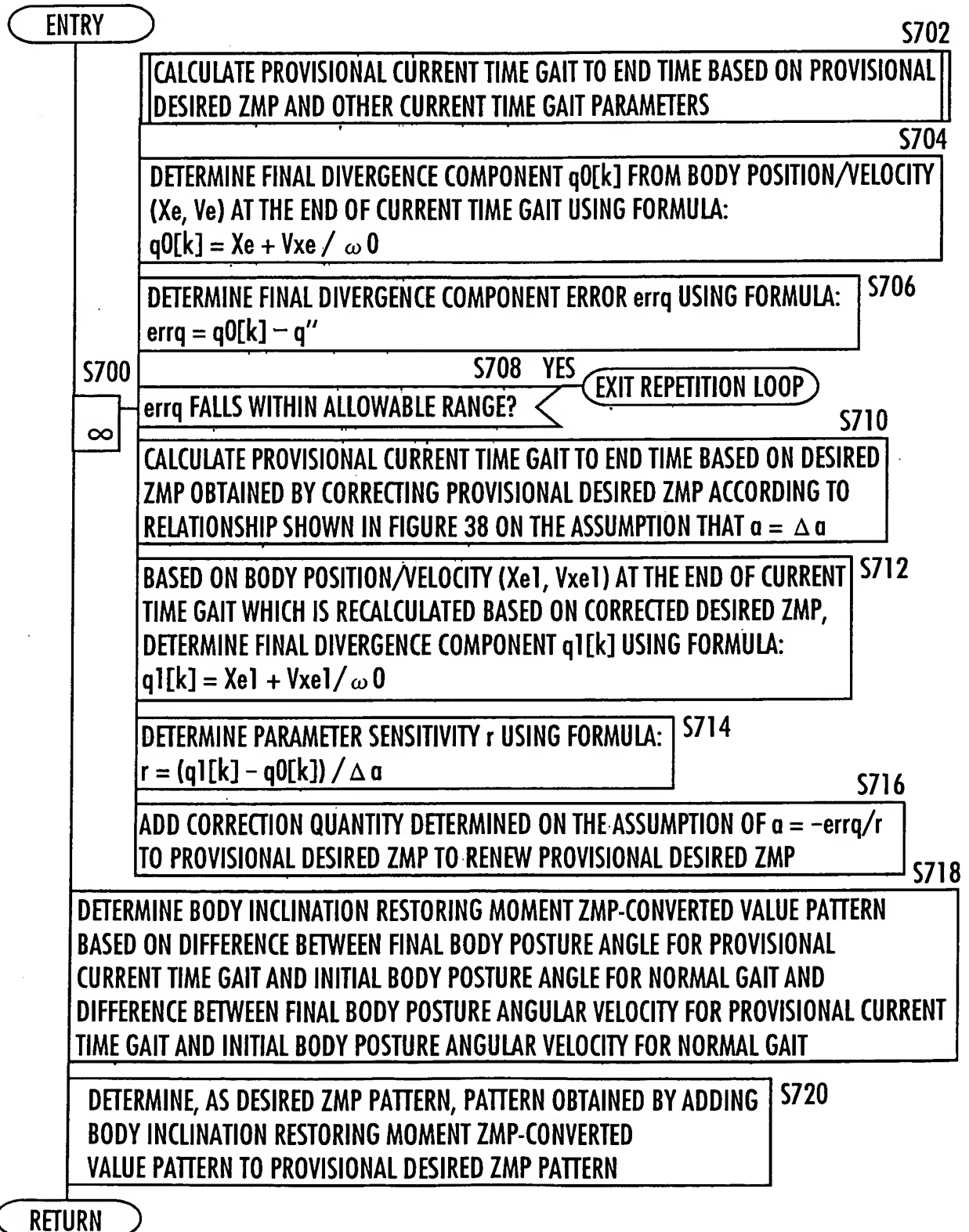


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FIG.34

(PROCESS OF CORRECTING CURRENT TIME GAIT PARAMETER IN SEARCHING MANNER)



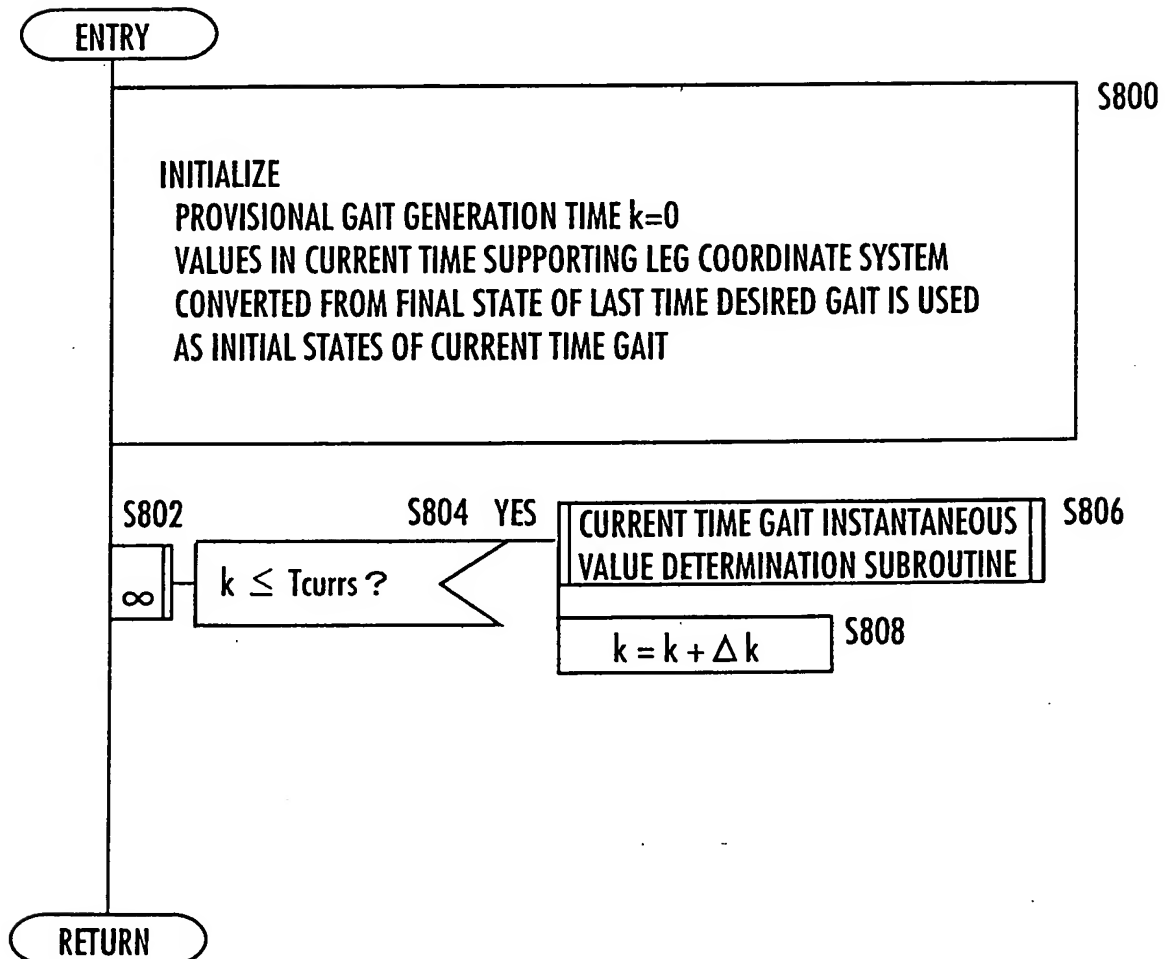
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FIG.35

(PROCESS OF GENERATING PROVISIONAL CURRENT TIME GAIT)

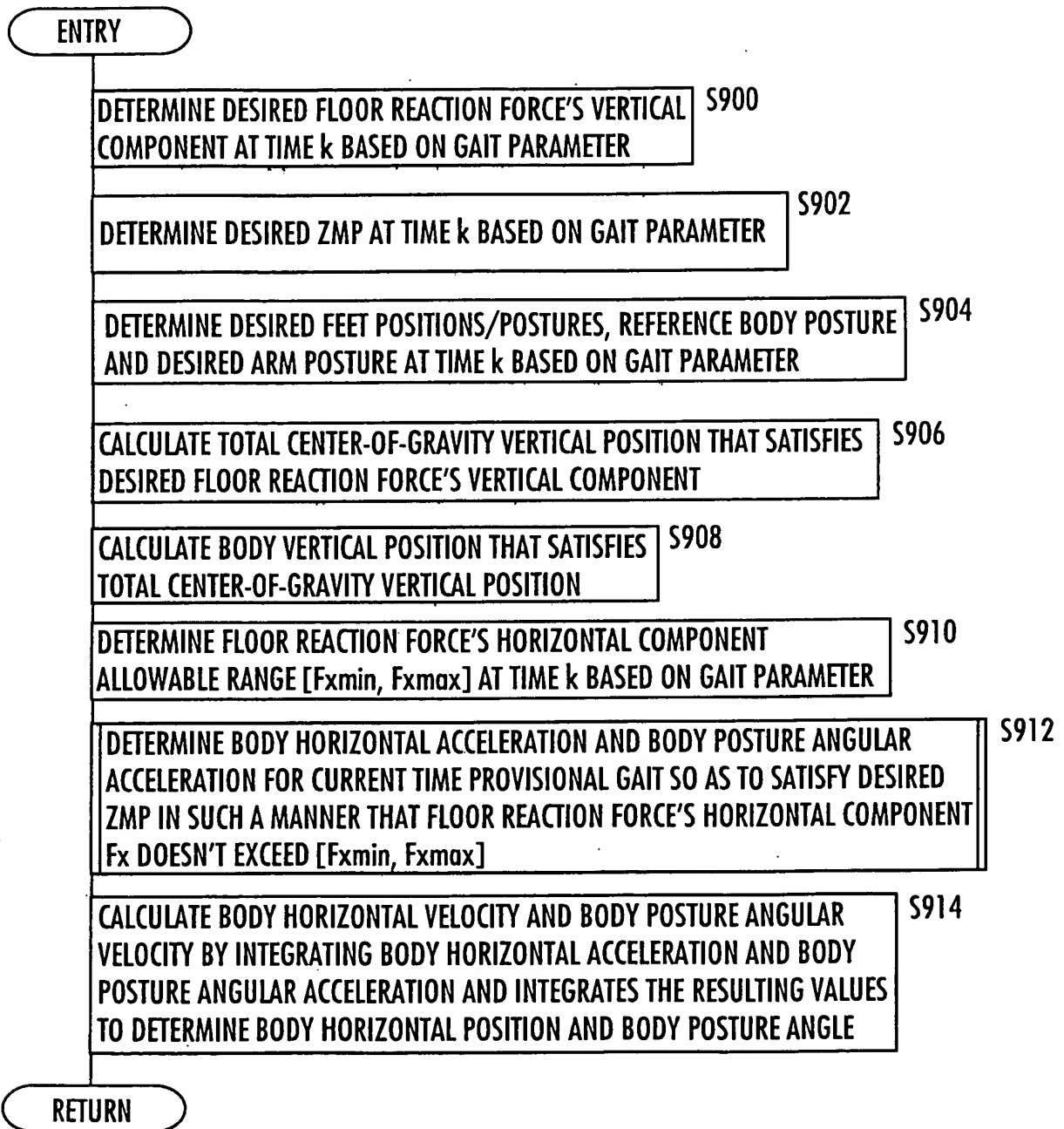


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FIG.36

(PROCESS OF DETERMINING CURRENT TIME PROVISIONAL GAIT INSTANTANEOUS VALUE)

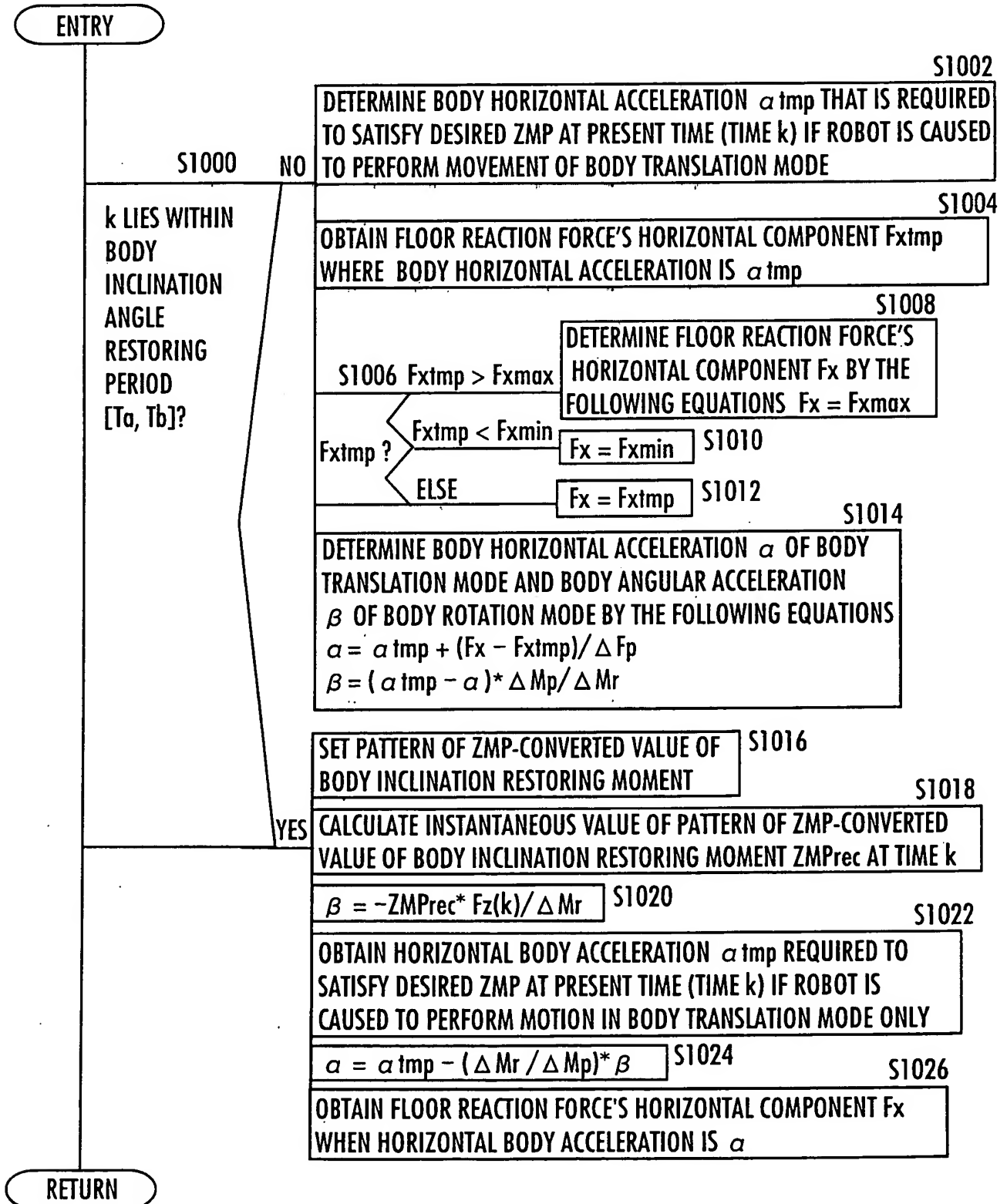


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FIG.37

(PROCESS OF DETERMINING BODY HORIZONTAL ACCELERATION AND BODY POSTURE ANGULAR ACCELERATION FOR PROVISIONAL CURRENT TIME GAIT)



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FIG.38

(CORRECTION OF DESIRED ZMP)

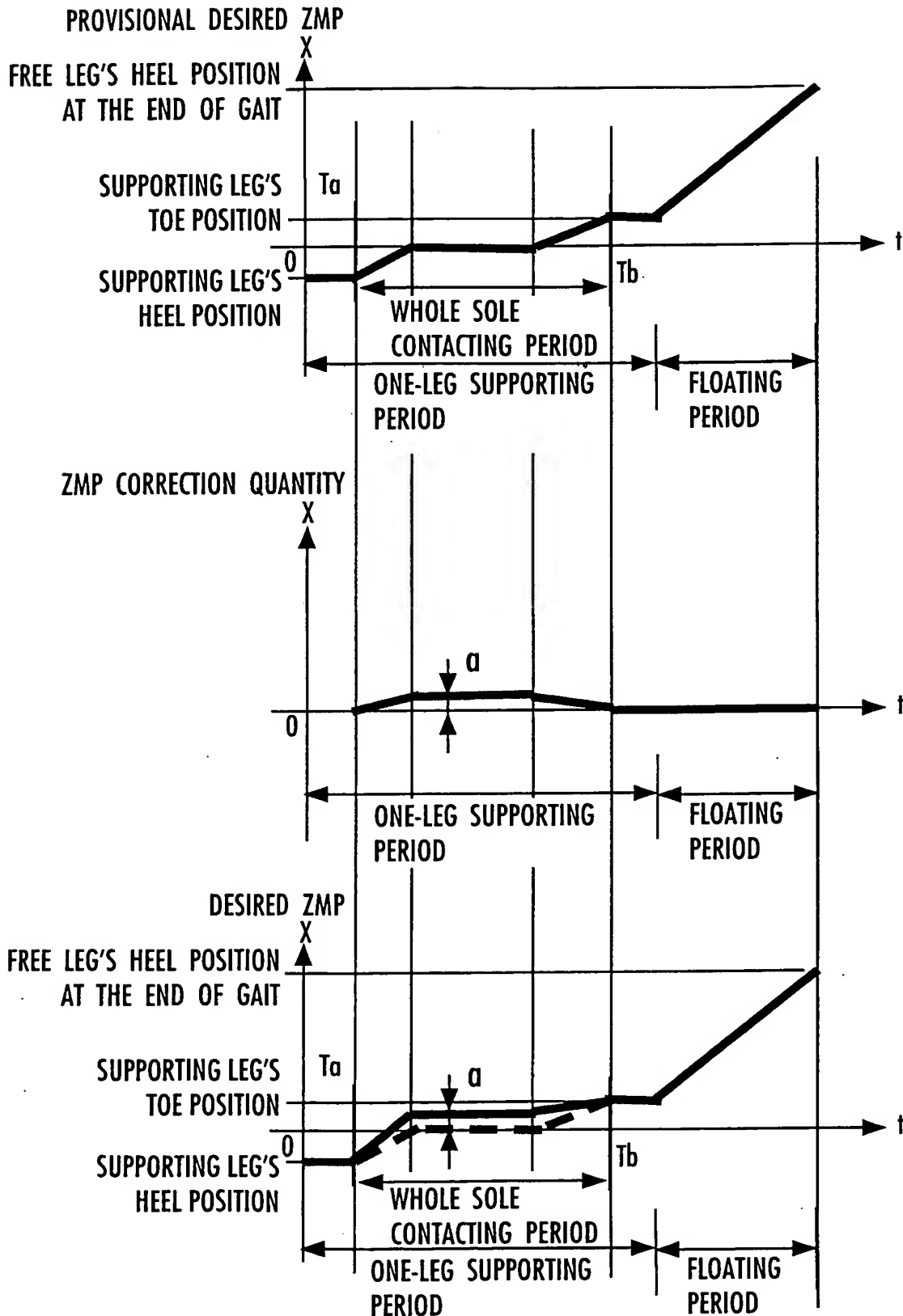
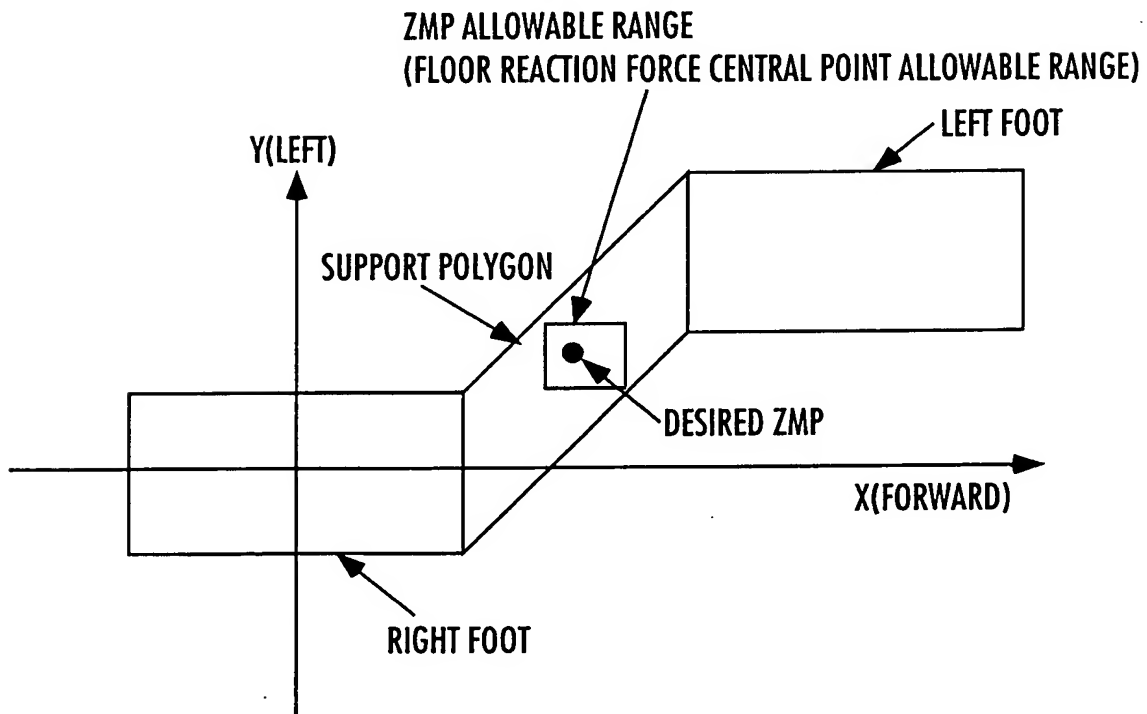


FIG.39

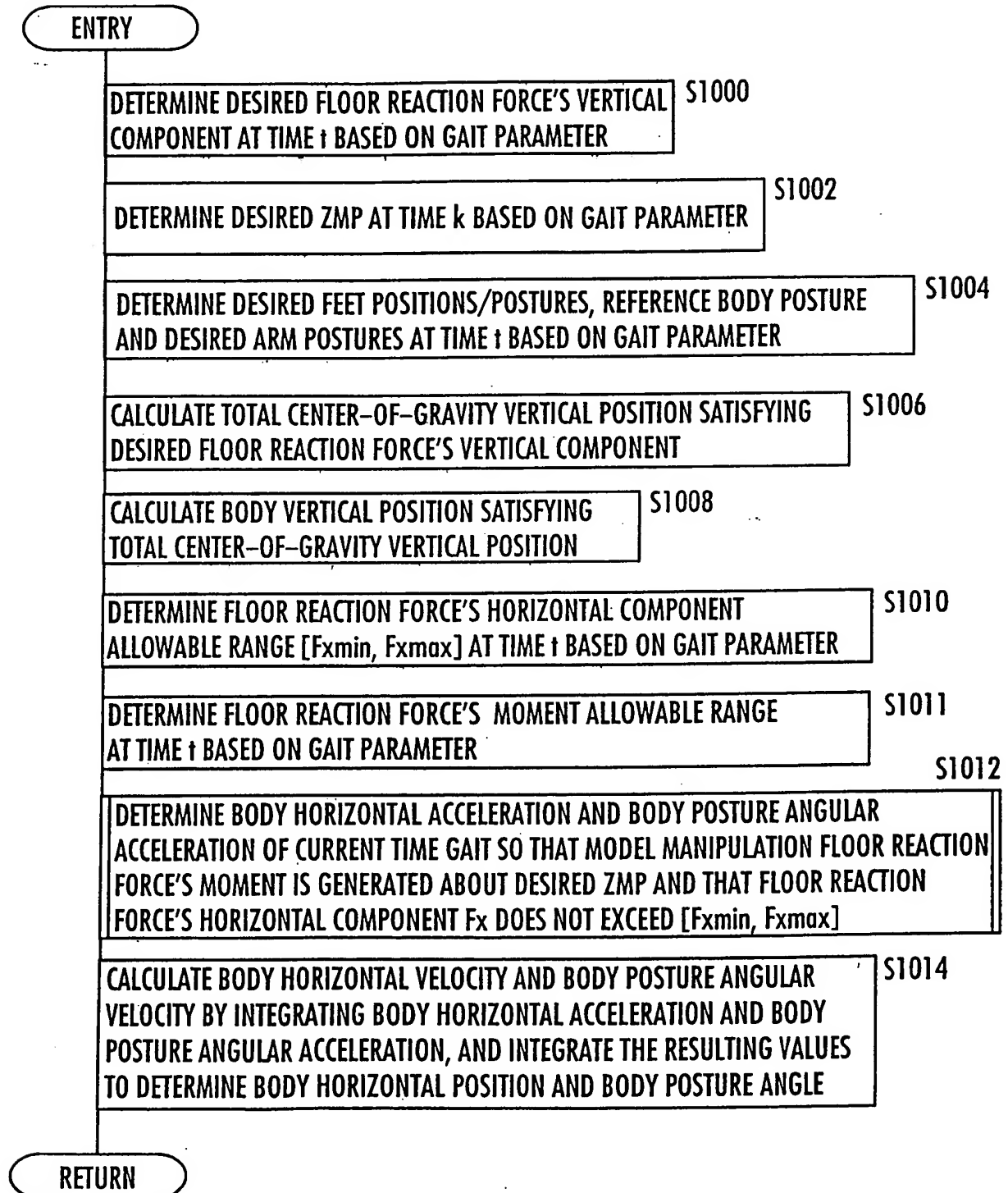
(SUPPORT POLYGON AND ZMP ALLOWABLE RANGE)



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FIG.40

(PROCESS OF DETERMINING CURRENT TIME GAIT INSTANTANEOUS VALUE)

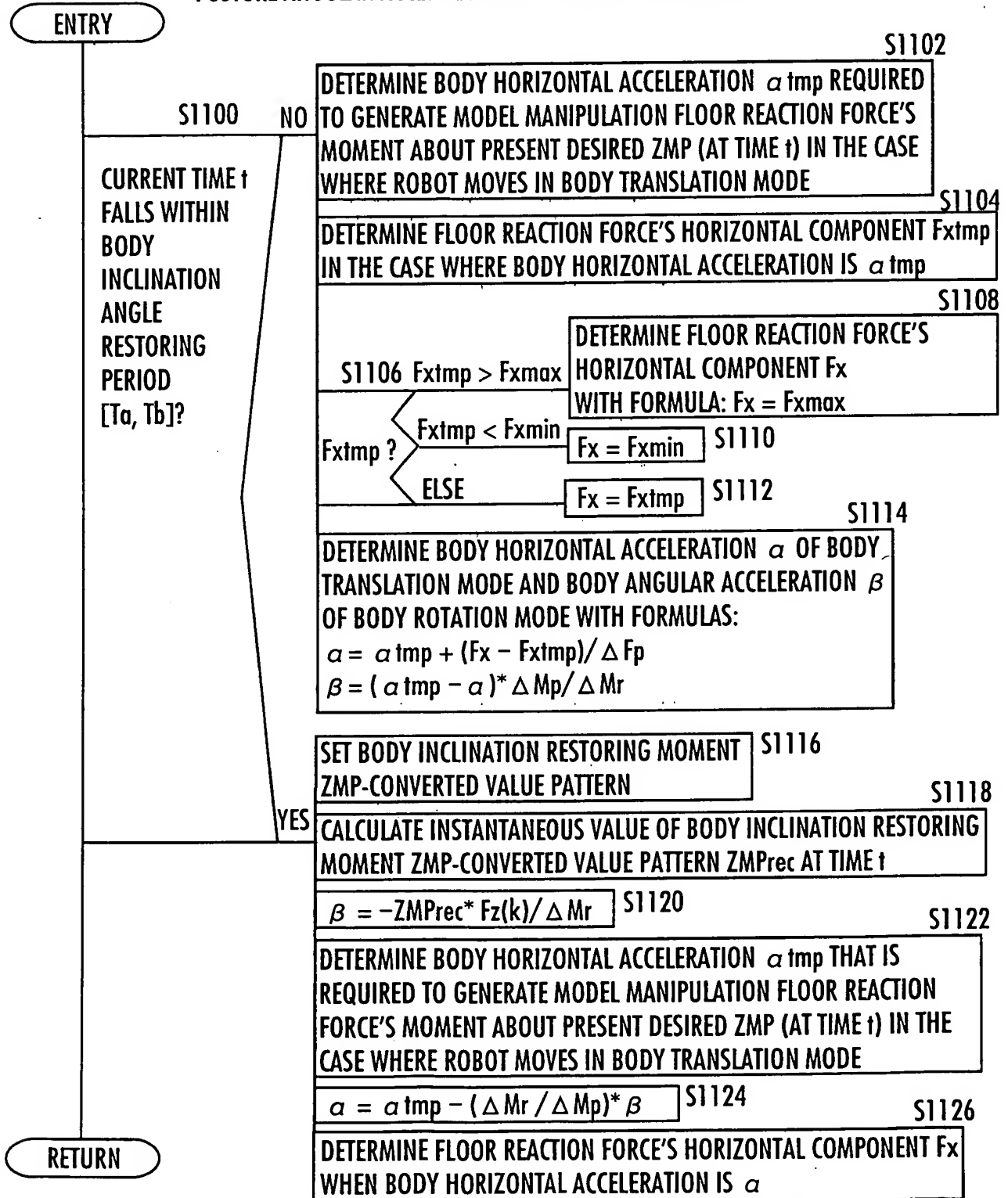


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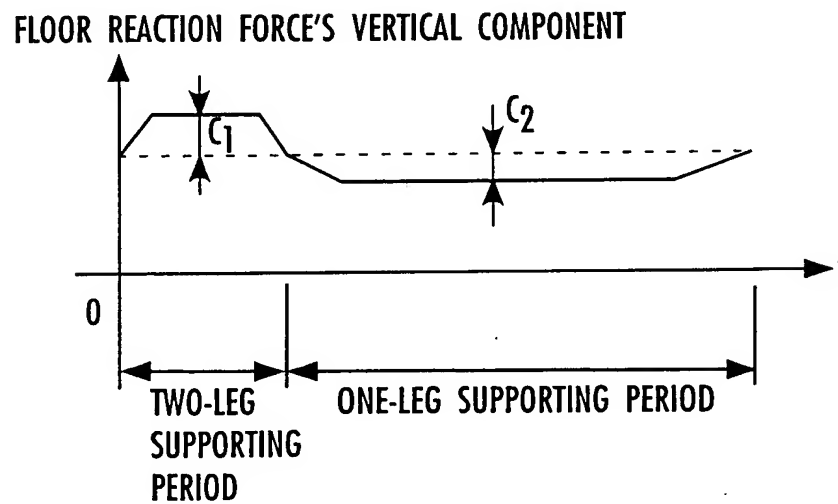
FIG.41

(PROCESS OF DETERMINING BODY HORIZONTAL ACCELERATION/BODY
 POSTURE ANGULAR ACCELERATION OF CURRENT TIME GAIT)



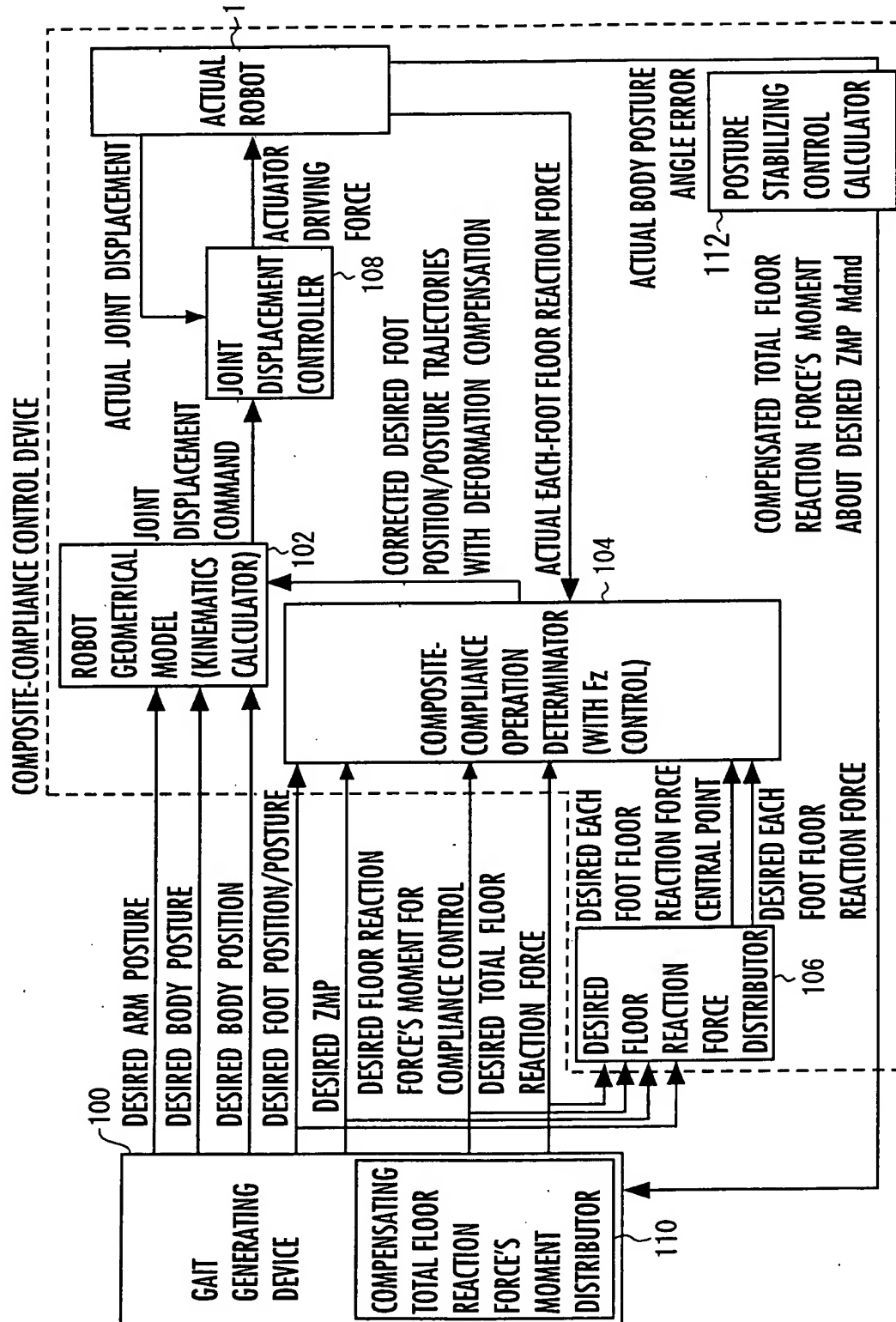
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FIG.42
(DESIRED FLOOR REACTION FORCE'S VERTICAL COMPONENT WHEN WALKING)



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FIG. 43

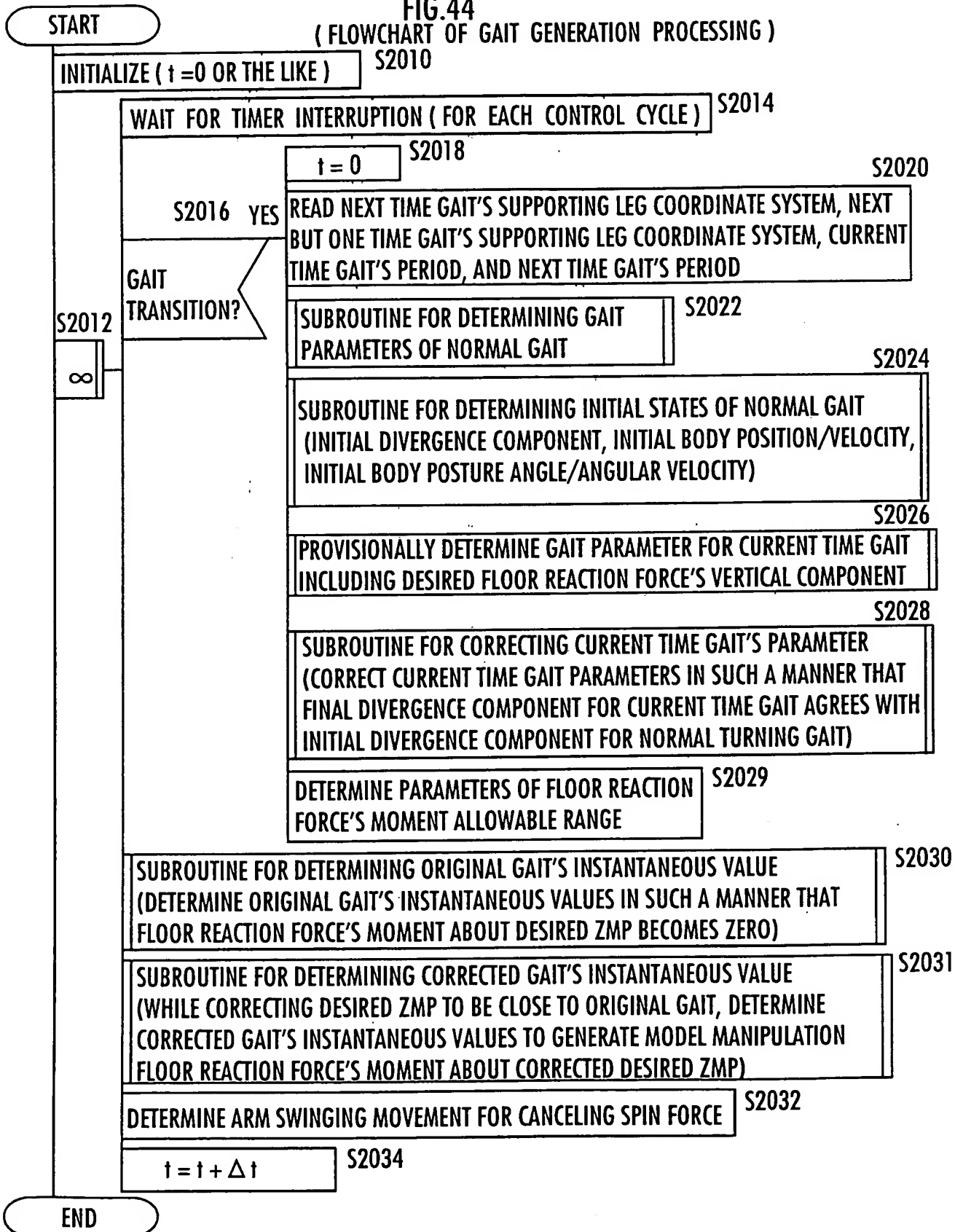


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FIG.44

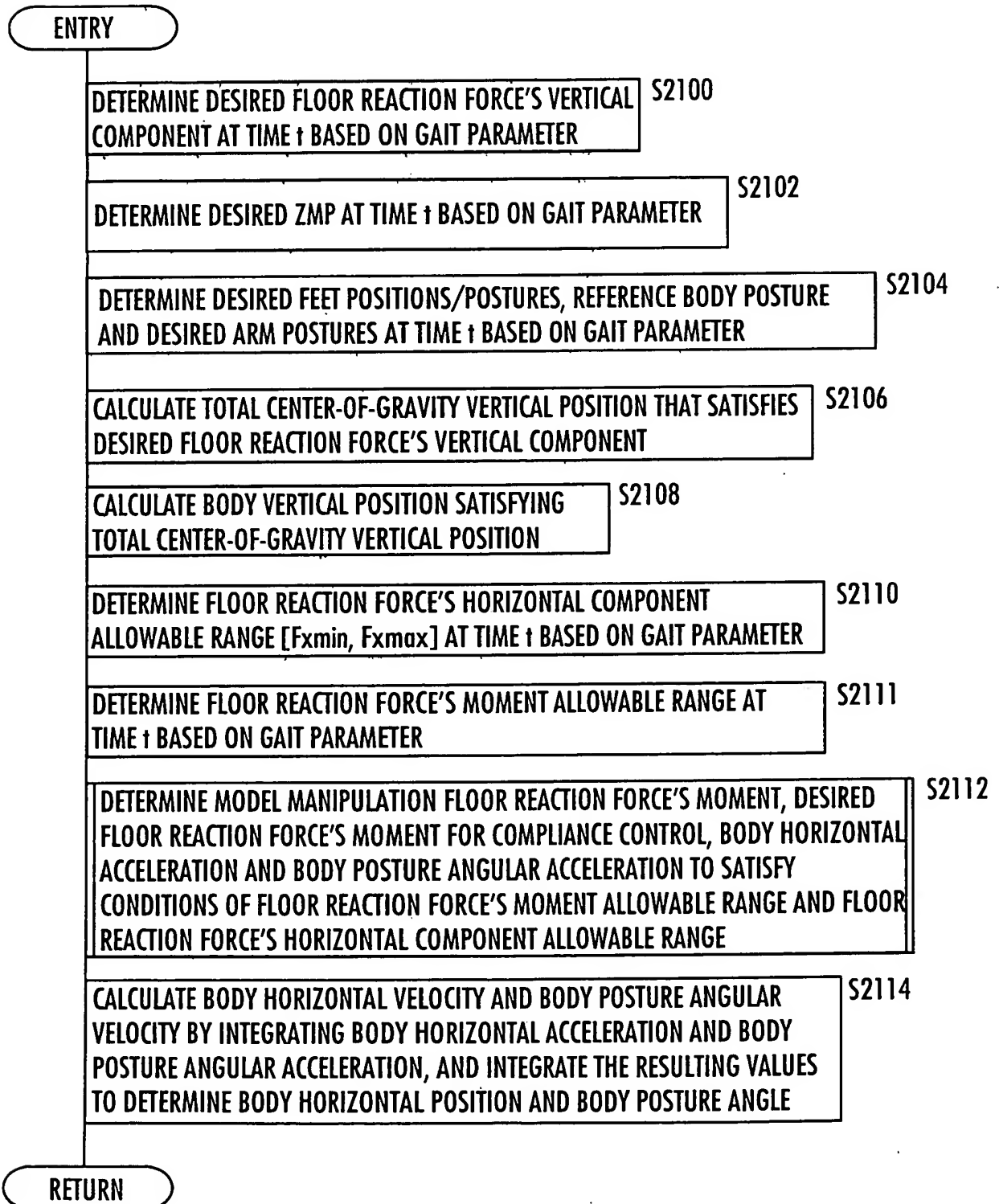
(FLOWCHART OF GAIT GENERATION PROCESSING)



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FIG.45

(PROCESS OF DETERMINING CURRENT TIME GAIT INSTANTANEOUS VALUE)



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FIG.46

(PROCESS OF DETERMINING BODY HORIZONTAL
ACCELERATION/BODY POSTURE ANGULAR ACCELERATION)

ENTRY

DETERMINE MODEL-TO-MODEL BODY HORIZONTAL POSITION DIFFERENCE S2200
WHICH IS DIFFERENCE BETWEEN BODY HORIZONTAL POSITION OF
CORRECTED GAIT AND BODY HORIZONTAL POSITION OF ORIGINAL GAIT

DETERMINE MODEL-TO-MODEL BODY POSTURE ANGLE DIFFERENCE S2202
WHICH IS DIFFERENCE BETWEEN BODY POSTURE ANGLE OF CORRECTED
GAIT AND BODY POSTURE ANGLE OF ORIGINAL GAIT

BASED ON MODEL-TO-MODEL BODY HORIZONTAL POSITION DIFFERENCE, S2204
DETERMINE REQUIRED VALUE OF MODEL'S BODY HORIZONTAL POSITION
STABILIZATION FLOOR REACTION FORCE'S MOMENT REQUIRED TO
CONVERGE THE DIFFERENCE TO ZERO

BASED ON MODEL-TO-MODEL BODY POSTURE ANGLE DIFFERENCE, S2206
DETERMINE REQUIRED VALUE OF MODEL'S BODY POSTURE ANGLE
STABILIZATION FLOOR REACTION FORCE'S MOMENT REQUIRED TO
CONVERGE THE DIFFERENCE TO ZERO

S2208
DETERMINE MODEL'S BODY HORIZONTAL POSITION STABILIZATION MOMENT
AND MODEL'S BODY POSTURE ANGLE STABILIZATION MOMENT TO SATISFY
RESTORING CONDITIONS, AND FURTHER DETERMINE BODY HORIZONTAL
ACCELERATION AND BODY POSTURE ANGULAR ACCELERATION.

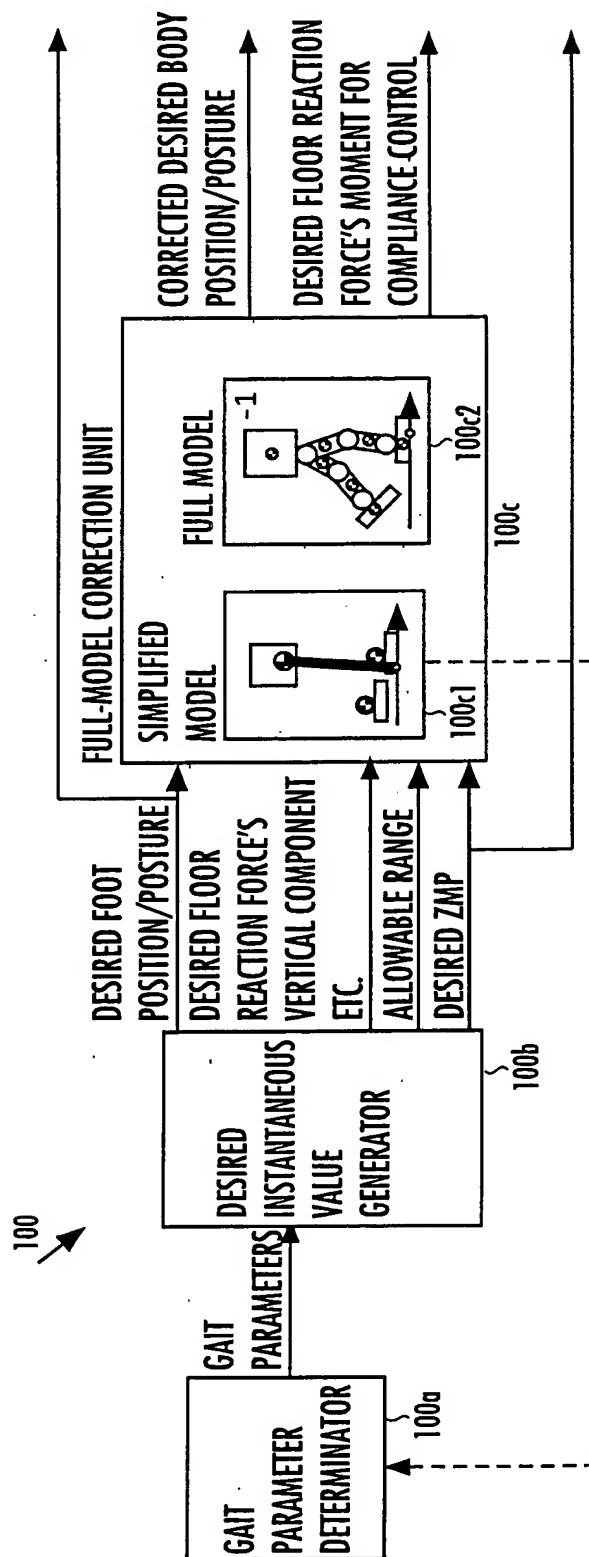
S2210
MODEL MANIPULATION FLOOR REACTION FORCE'S MOMENT
= MODEL'S BODY HORIZONTAL POSITION STABILIZATION MOMENT
+ MODEL'S BODY POSTURE ANGLE STABILIZATION MOMENT

S2212
DESIRED FLOOR REACTION FORCE'S MOMENT FOR COMPLIANCE CONTROL
= COMPENSATING TOTAL FLOOR REACTION FORCE'S MOMENT M_{dmd}
+ MODEL MANIPULATION FLOOR REACTION FORCE'S MOMENT

RETURN

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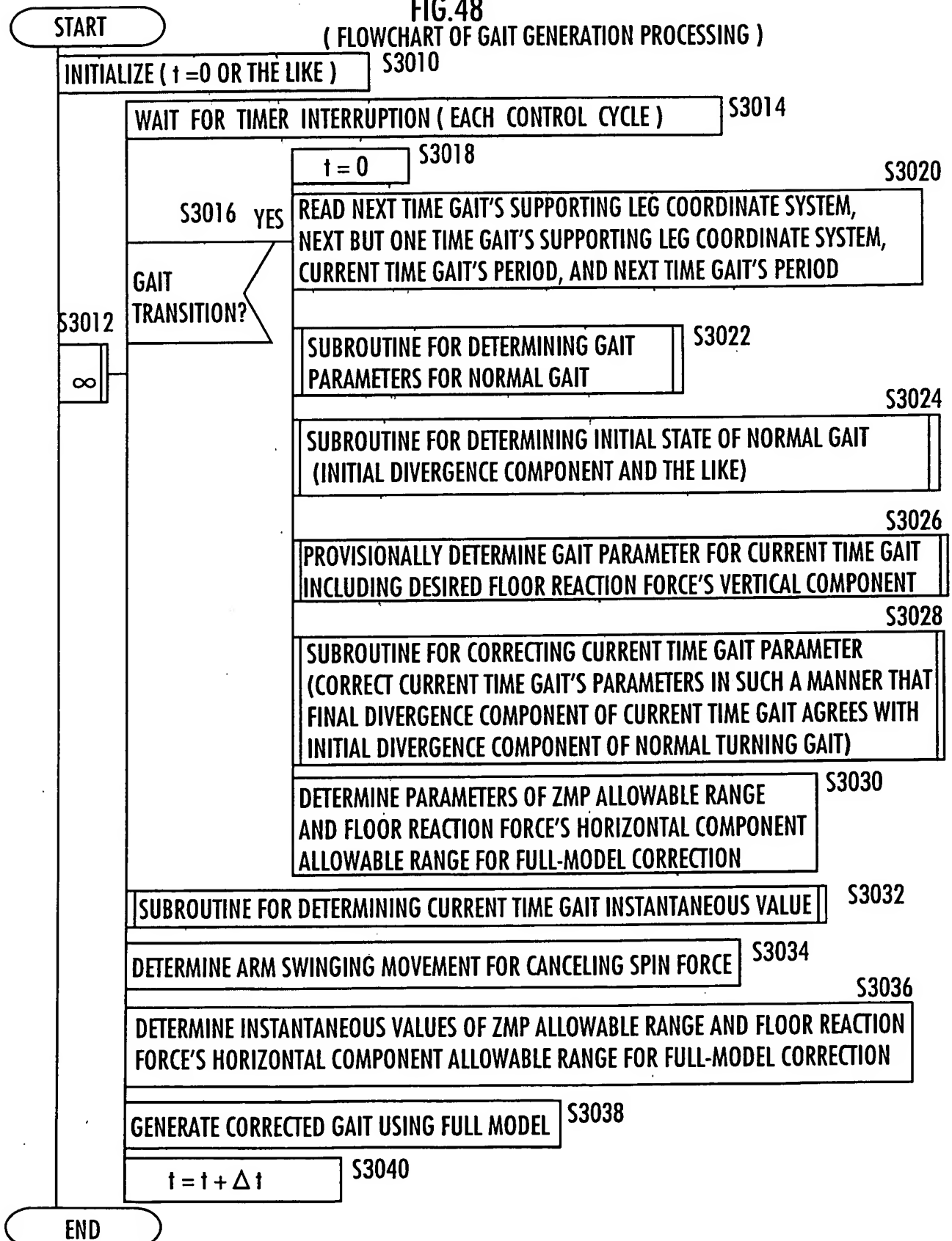
FIG.47
 (FUNCTIONAL BLOCK DIAGRAM OF GAIT GENERATING DEVICE WITH FULL-MODEL CORRECTION)



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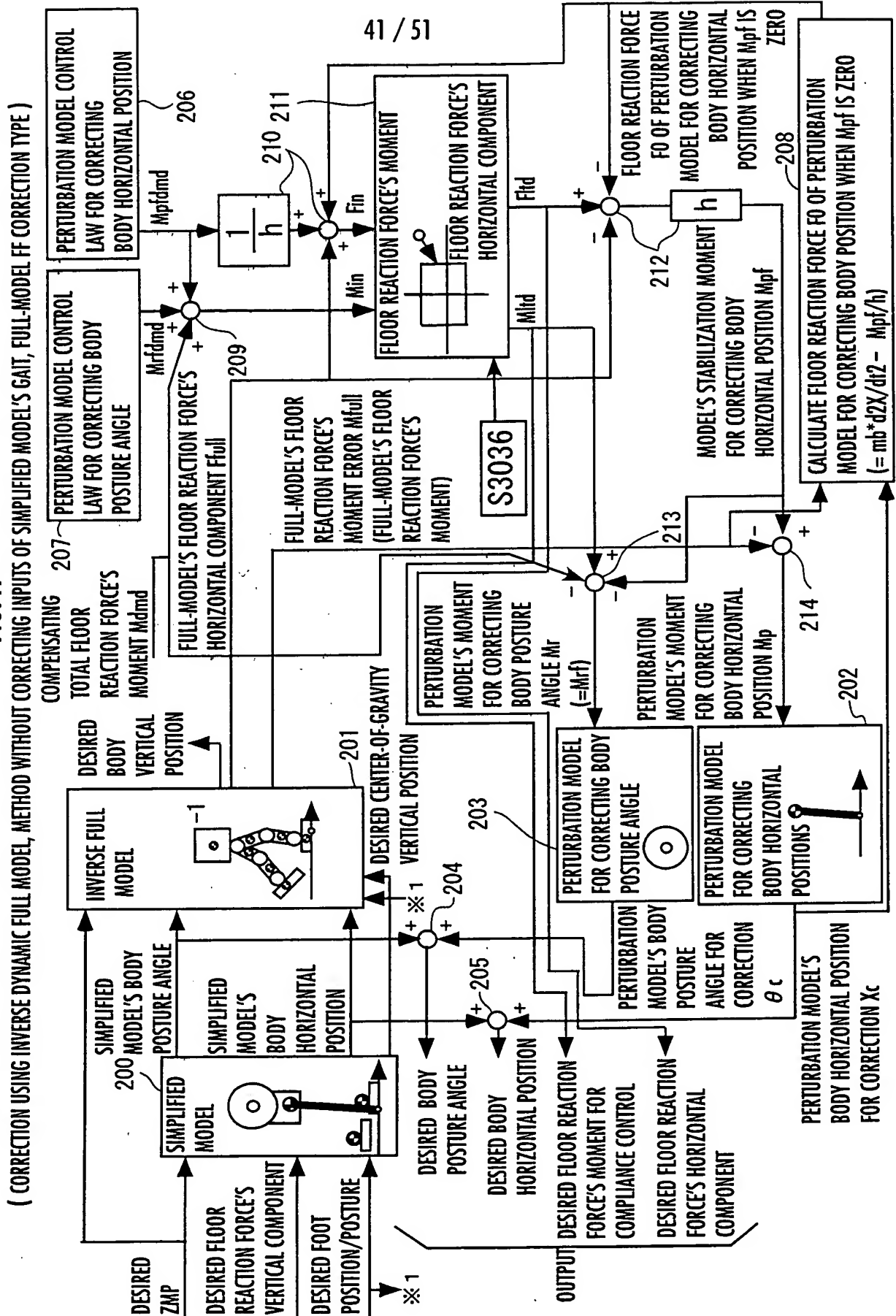
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 FIG.48

(FLOWCHART OF GAIT GENERATION PROCESSING)



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FIG. 49



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FIG.50

(PERTURBATION MODEL FOR CORRECTING HORIZONTAL BODY POSITION)

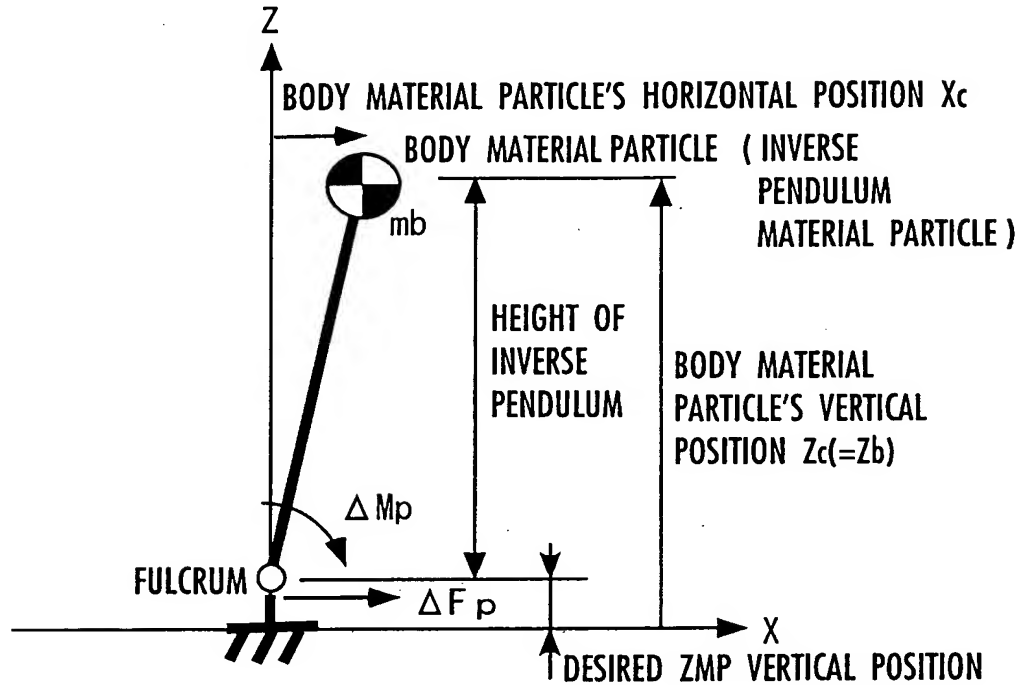
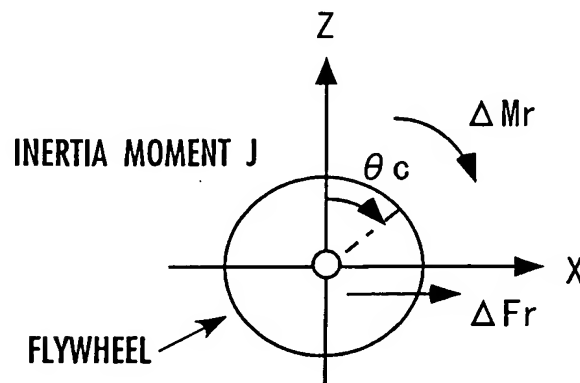


FIG.51

(PERTURBATION MODEL FOR CORRECTING BODY POSTURE ANGLES)



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FIG.52

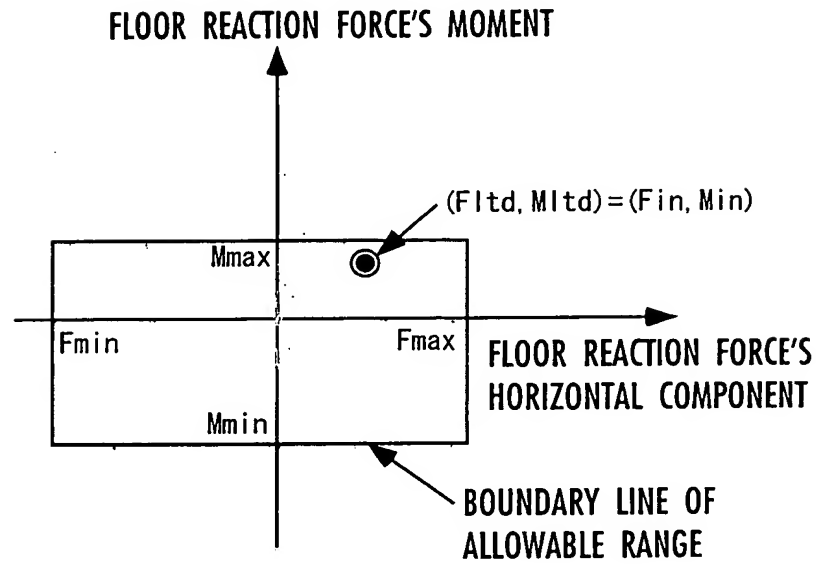
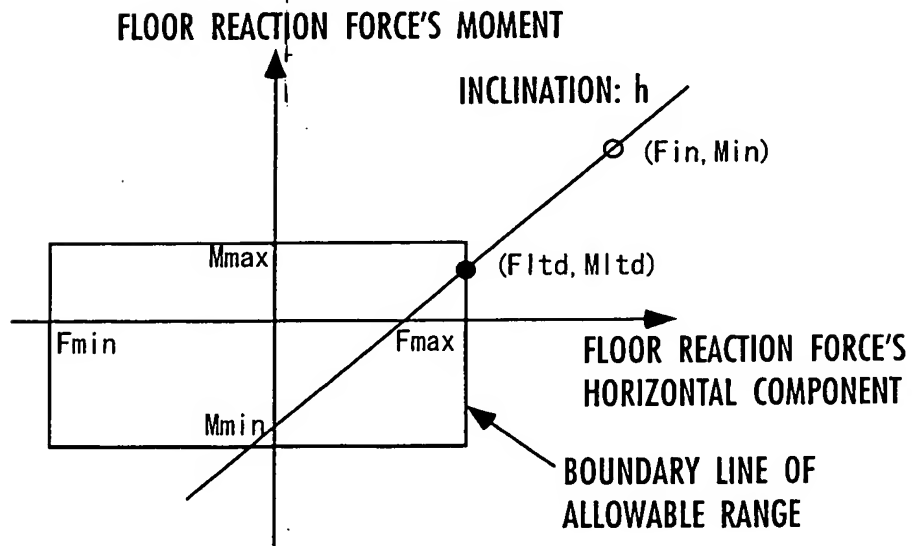


FIG.53



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FIG.54

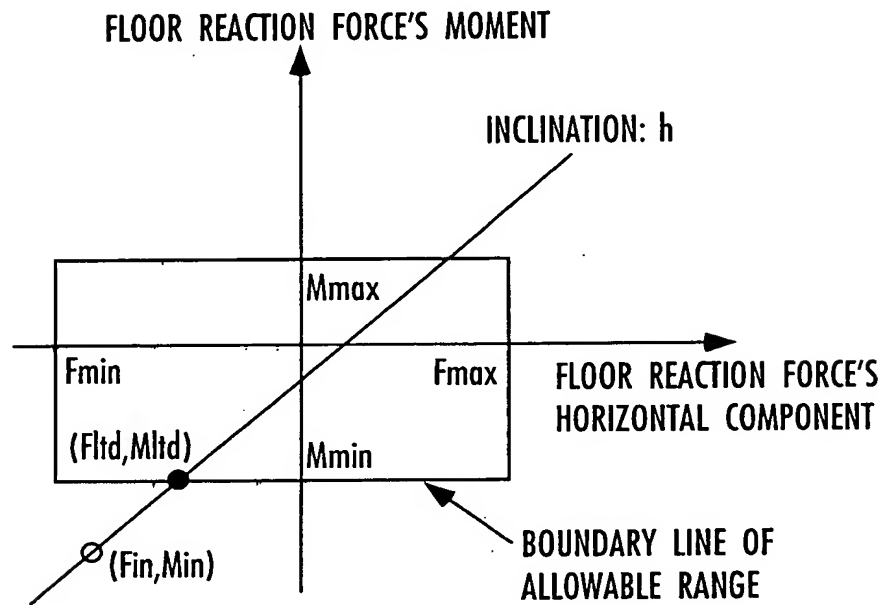
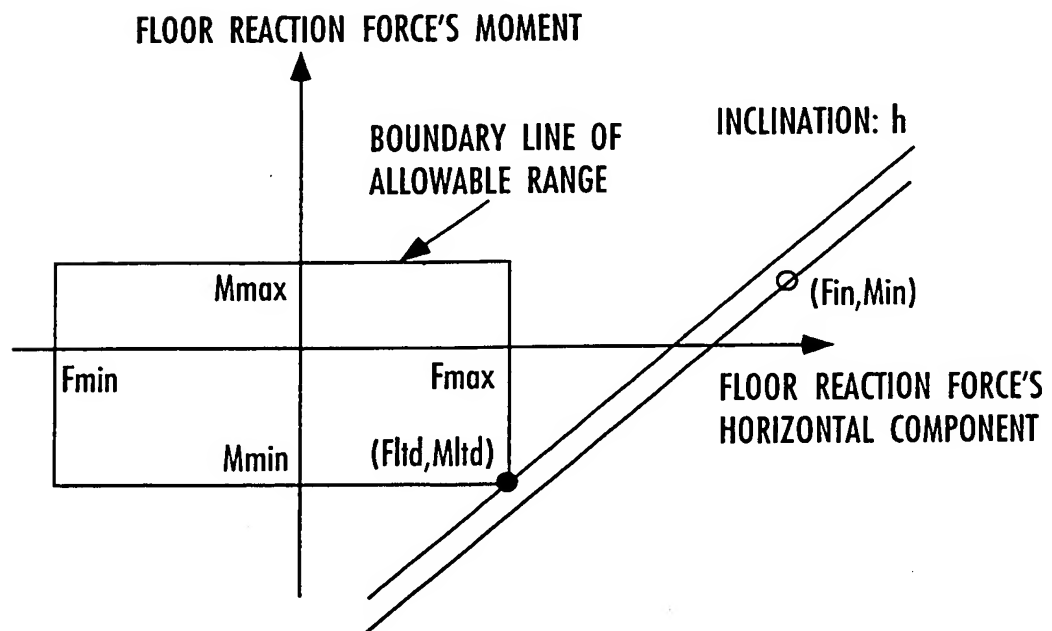
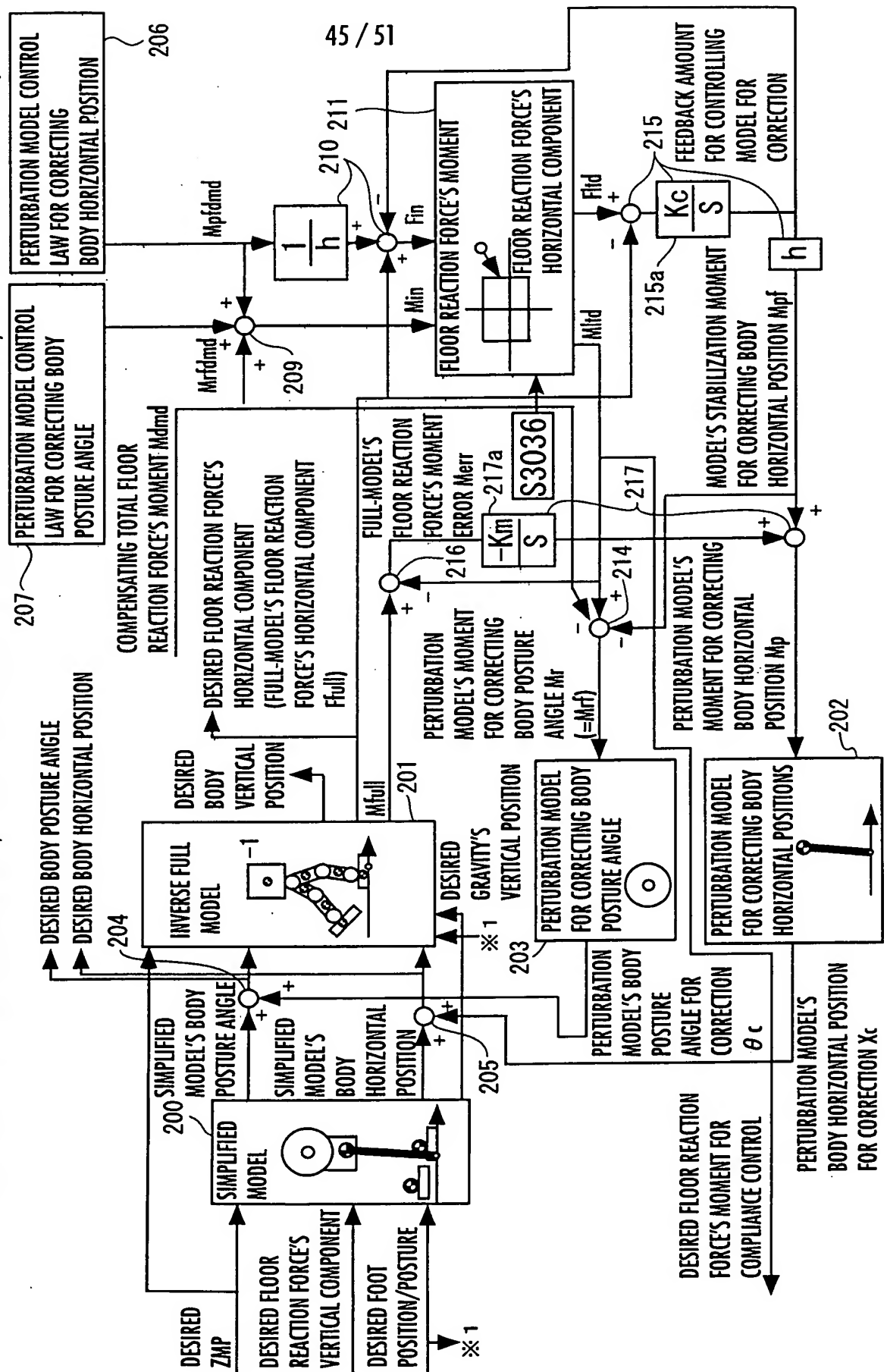


FIG.55



(CORRECTION USING INVERSE DYNAMIC FULL MODEL, METHOD WITHOUT CORRECTING INPUTS OF SIMPLIFIED MODEL'S GAIT, FULL-MODEL FB CORRECTION TYPE)



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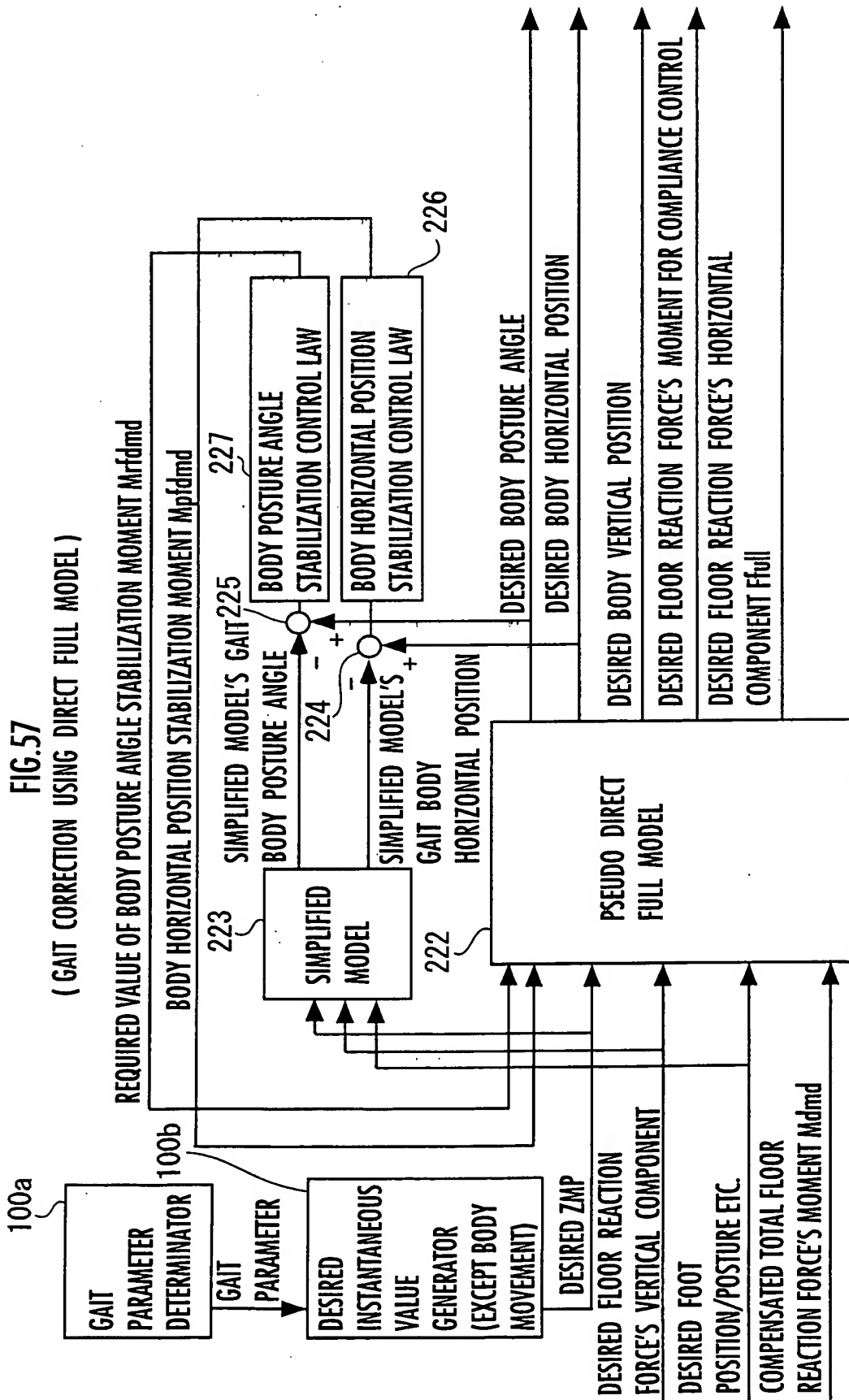
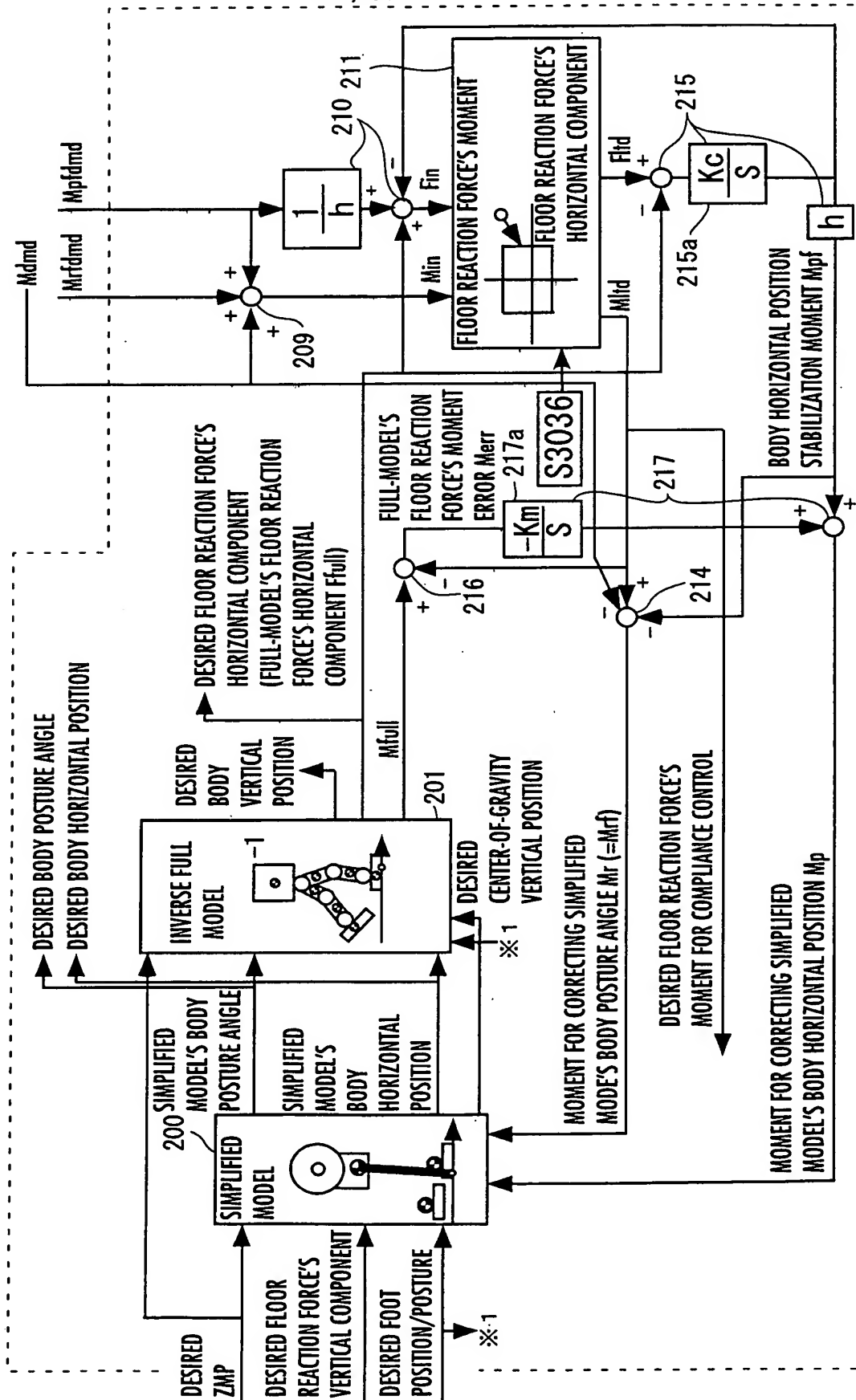
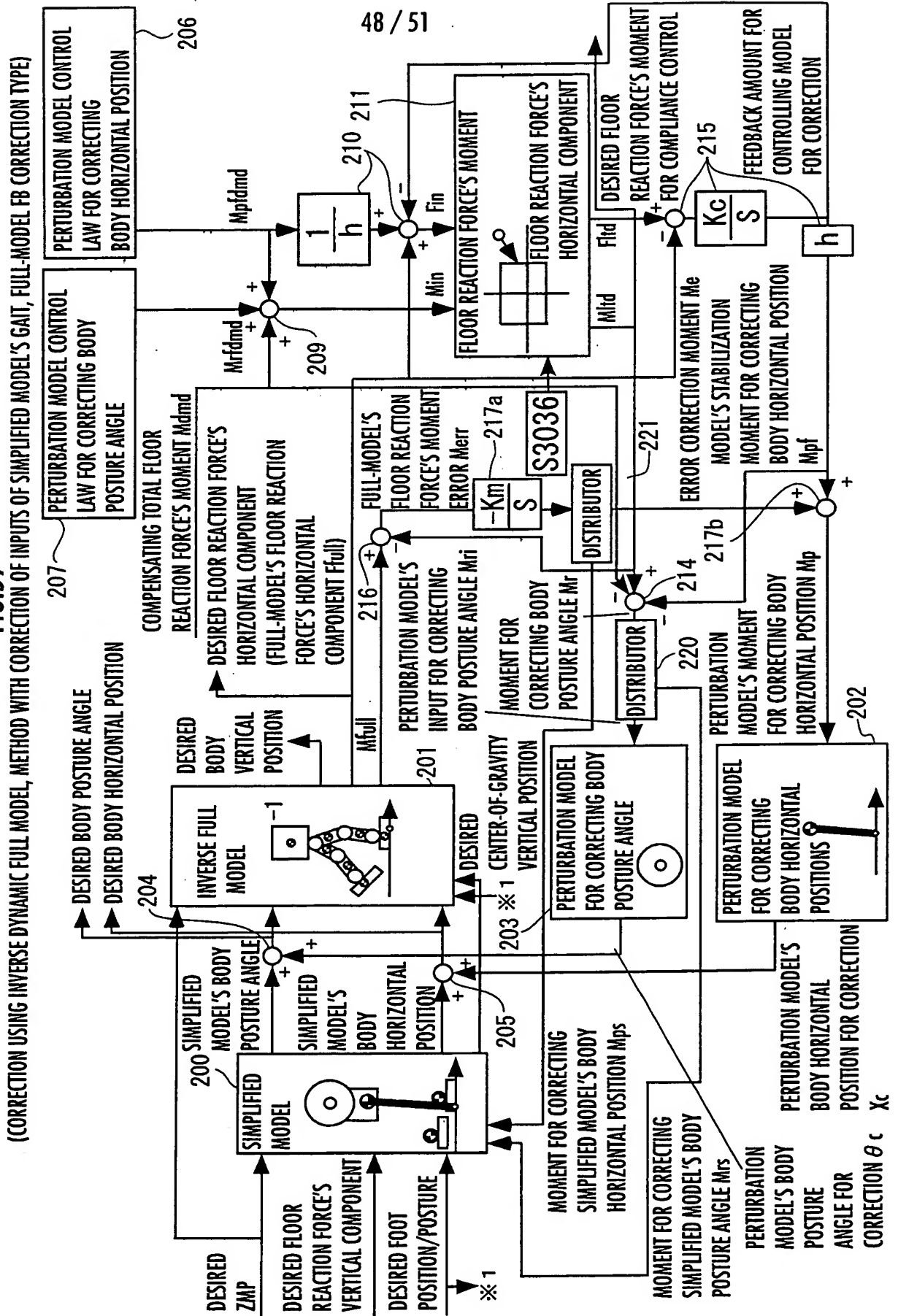


FIG. 58
(PSEUDO DIRECT FULL MODEL)



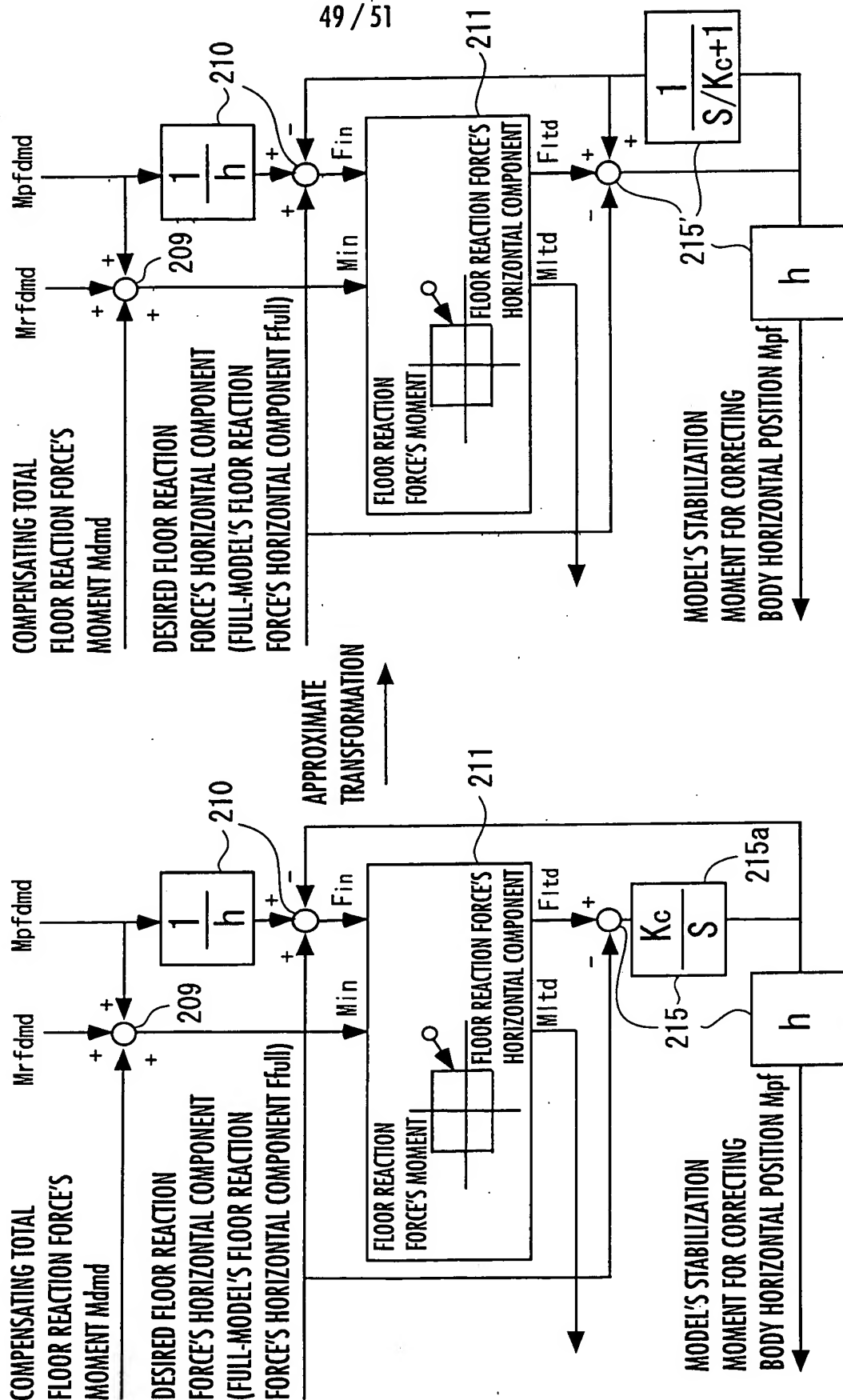
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FIG. 59



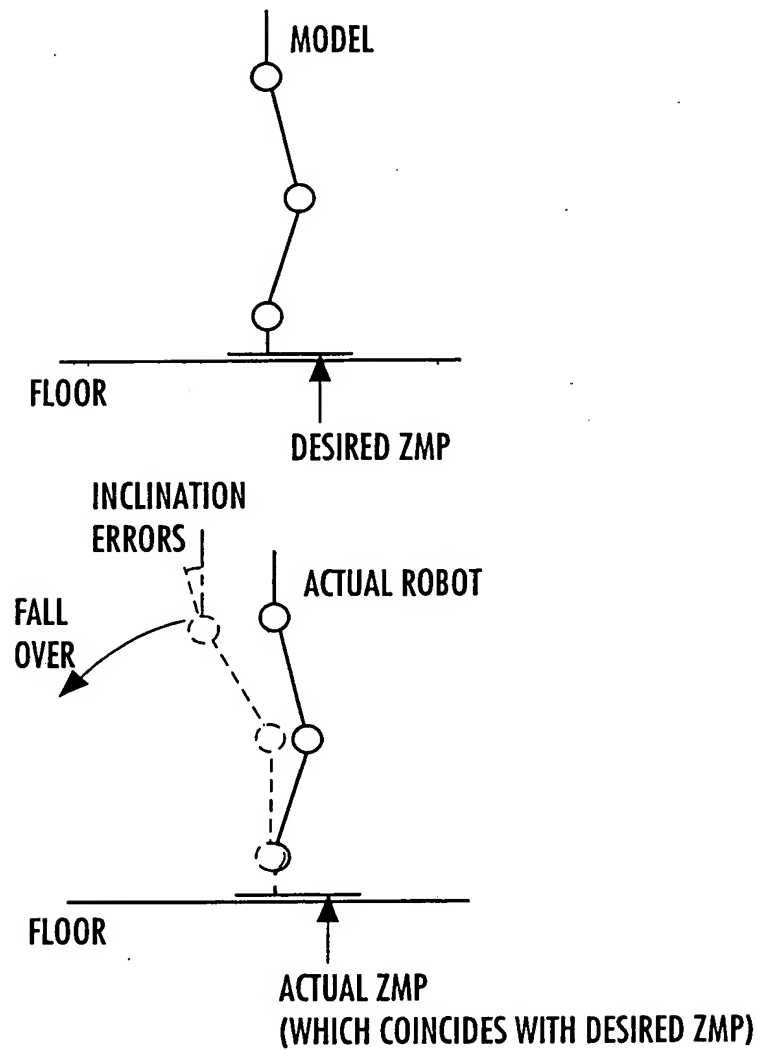
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FIG.60
 (APPROXIMATE TRANSFORMATION OF LIMITING MEANS)



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FIG. 61



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FIG. 62

